SOLVE
COAGULA
CLIPHAS

There is a worldwide elite kabbalistic transgender cult that has been around for an unknown period. It has its roots in the Talmudic/Kabbalist interpretation of Genesis, the ideal being created as an androgyne according to their interpretation. Then it spread to other cults like the Knights Templar and their androgenous Baphomet. The Freemasons are derived from them and at higher levels are totally androgynes. It is also among the highest grades of the Hindu and Buddhist initiates.

Technology has greatly aided it's spread, hormones being a major component of making the deception harder to spot, along with breeding humans outside of a human womb(ectogenesis) and IVF. This requires technology that only came about in the late 19th and early 20th century. The advances in plastic surgery and regular surgery also have made it much more widespread. The moving images industry also perfected the art of lighting, makeup, framing and other tricks.

It includes entertainment(which includes major sports and what's called news media), politics, royalty, the talmudic/kabbalist pagan cult, high officials such as CEOs, UN and other regional and internationalist organizations such as the EU, IMF etc It has spread to the general population in a pre planned forced way by these elite and is sterilizing and spreading sickness for reasons of depopulation and of course the very profitable costly lifestyle.

I'll just go through each major elite high profile industry and give a few names. Remember this is a worldwide satanic cult, the proportions of trans in other countries in the mentioned industries will be the same. I don't have the time to research all industries that are seeded by the elite, for transgender in the NGO, UN, EU, academia and medical spheres I recommend the Transgender Industrial Complex book. Then will proceed to describe how to determine biological sex from the available information with some examples. A discussion of the philosophical and religious underpinnings after that. Some conclusions. I'm going to include some images that will show likely transgendered well known people, with reliable finger digit ratios where possible.

Hollywood

It counts almost all major actors in hollywood since it's inception. Names from early Hollywood like Gloria Swanson, Eleanor Powell, Joan Crawford, Bette Davis, Barbara Stanwyck, Glenn Ford, Gary Cooper, Jimmy Stewart, Doris Day, Ronald Reagan and many many more as to be almost ALL of hollywood and similar industries. Both female and males are in fact opposite of their purported gender. Modern hollywood is also completely transgendered names like Ryan Gosling, Matt Damon, Brad Pitt and many others. Those who present themselves as female in hollywood are completely transgendered MTFs little to no exceptions.Television is also completely transgendered with few exceptions.

Music

Barbara Streisand, Mariah Carey, Celine Dion, Brittny Spears, Christina Aguilara, Wayne Newton, Elvis Pressly, Lorde, Madonna, Lady Gaga, Lana Del Rey and many more. It's possible that figures like Pavarotti and Bocelli as well I have not looked at them all. Possible trans castrato. One of the latest ones is Harry Stiles and FTM. I suspect so called macho men like Dr Dre and similar in hip hop as well.

Fashion/Luxury

All fashion models are inverted, especially the ones that claim to be female. All

QVOD SVPERIVS MACROPROSOPVS
MICROPROSOPVS
QVOD INFERIVS

the supermodels are in fact MTFs. Cindy Crawford, Cara Delvigne, Kate Hudson and all the rest are transgendered. I don't know the names of male models but you can bet they are FTMs. The designers themselves are largely transgendered as well as the whole millieu such as journalists etc

Politics
In politics there is strong evidence of people like Eleanor Roosevelt, FDR, the Hoovers, Mamie Eisenhower, Jackie Kennedy, Jack Kennedy, Ladybird Johnson and on down to the Reagans, Michelle Obama, Donald and Melania Trump, the Bidens and also surrounding figures like Henry Kissinger and his very masculine wife along with almost all other lower level government figures and this is just the USA! It seems that all presidential couples have actually been inverted since the early 20th century. The Senate and Congress are almost totally transgenders with an emphasis on the ones that claim to be female. Governors, state legislators and other local and regional figures. The supreme court of the USA is largely transgenders, the purported women are all trans and some of the men.

Major Sports
The Williams sisters, Tom Brady, Russell Wilson, all female wrestlers, all female tennis players, Dennis Rodman and other NBA players, many many Olympics stars, danica patrick and most likely a lot of auto racing stars and many more in other sports.

Royalty
I have not looked at much there but it looks like the Grimaldis of Monaco have transgenders, Grace Kelly was transgender and her IVF ectogenic children are also trans. In the British royal family at least Kate Middleton and Meghan Markle are transgenders with Prince Harry having a strong FTM look which I will get into later.

CEOs
It looks like almost all "female" CEOs and similar high profile levels are in fact MTFs. CEOs and similar are a part of the elite trans cult and their offspring will be too. Elon Musk is an FTM, with Apple CEO Tim Cook being very suspect. As mentioned Donald Trump is an FTM and his wives have been MTFs, the IVF ectogenic children are also raised in the trans cult from an early age.

News Media/Press/Public relations etc
Just looking at a few of them shows that they are largely transgendered. Megan Kelly, Dana Perino and a host of others are obvious trans. Oprah Winfrey, Ellen Degeneris, Rosie O Donnell, kelly ripa etc There are men who are trans there too, always remember if you can spot the obvious ones then they are just the tip of the iceberg and that is ALL of them.

High Level Academia
High Level Health industry

Key points in differentiating the natual sex

Number one above all is finger digit ratio right off the bat because it's purportedly 95% accurate and not easily changed as well as there being ample

evidence of training to hide the fingers in video and still photos. As I've said stills are edited regularly for this but not always and even finger prosthetics are used. So finding a non edited image of finger ratio is key here. Recommend at home movies and pausing it where fingers are next to each other low action type of scene.

For a natural man
Jaw bone is square, it goes down from the ear and a sharp angle. Not always but it's one of the signs. Generally a larger overall face, wide chin, eyes are farther apart, top lip comes down flat mostly, large nose, eyes are more sunken, over arching brow protruding brow umbrella, flat space between the eyebrows, hairline is high. Prominent adams apple, not always though. Hard, bony looking, rough skin. Obvious lower voice that sounds natural. Shoulders are straight across, none to little sloping. Longer arm bones. Longer torso, adonis belt. No scars or irregularities around the breasts. No curviness around the hips or minimal. Finger ratio for a man(pointing finger shorter than ring finger), sometimes larger hands with prominent veins. Large feet, bony knees. Fat distribution as it gets older is belly fat mostly. Narrow hips as it gets older. Flat back leading down to a lower buttocks which is generally small. Lanky legs that taper a lot at the ankles, more bony overall.

For a natural woman
Softer and smaller overall, no sharp curves anywhere no sudden changes in body structure. Finger ratio, pointing finger is longer than ring finger OR pointing finger is equal to ring finger. A layer of soft fat under the skin everywhere. Softer smoother skin as a result. No brow ridge or very minimal, facial features like eyes and nose are smaller and close together. Hairline is lower. None to slight adams apple. Hips start above the belly button. Wide hips for a baby to pass through no pencil thin torsos or adonis belt. Curvy overall especially hips. Smaller hands and feet, no bony knees. Jaw bone is subtle no sharp angles or it has a wide angle. Eyes have some curve to them. Top lip comes up more. Fuller lips. Smooth continuous forhead no obvious bumps or flat spots. Voice is natural sounding not drag queen or studied. Curve in the spine leading to a wider larger buttocks. Calfs are more uniform and don't taper as much at the ankle.

Observations
Usually if you have very odd looking bodys you will have a trans. Wayne Newton comes to mind if you look at his older photos it looks very odd, top heavy to hide the wide hips and probably some breast development from cutting back on the hormones for safety reasons as he got older. Newtons young face is very large but feminine looking. Clint Eastwood has a very odd body now that he's older, wide hips, some fat distribution starting below the belly button of a female and almsot noting on the upper body. He had a breast removal as a young woman that left some nasty scars and strange pits if you look closely at movies and some still pictures. He also has no adonis belt but does have side flanks that are there for his female wide hips, hidden carefully. FTMs build up the upper body to hide the hips and wear clothing that hides them or that directs the eye to the upper body. They also have a way of trying to make the side flank female hip protrusion to look like a muscle they have been working. Their hips usually start above the belly button in accordance with female body structure but they may be able to hide it or disguise it with clothing and also workouts/growth hormones that make the back muscles come in obscuring it.

A method of identifying biological sex/gender

For me it's about a holistic approach which includes visual and research of the candidates life from available sources. Primarily the still and moving images of the body of the person which means proportions, finger digit ratios, how they look at different points of their lives ie young, middle aged, older photos. You have to remember that there is a conspiracy with plenty of unseen helpers so a lot of the still photos are doctored, especially finger ratios because thats a very difficult and painful thing to change. I've seen different pictures of the same person same hand with different finger ratios. Some do get through in the stills but usually it's older stars and especially stars of modern times when the trans lifestyle is being pushed and laws are made to make it a hate crime etc to question these people. They can and do use finger prosthetics at times and also body prosthetics for curvyness or to hide the curvyness. Also if the person obviously has had a ton of plastic surgery that looks atrocious as they get older because MTFs have to do that to hide the emerging manliness as they age, FTM's don't need to do that as much because natural women get more manly looking as they age due to lower estrogen, menopause etc

Evidence of a training regime gives a soft form of evidence of hidden trans. Effort to hide the fingers is there and unnatural finger and body poses that either hide or accentuate curves, adonis belts and other aspects that tend to be exclusive to one gender. If someone has obviously had finger surgery then they are very suspect, Johnny Depp, an FTM, has had a lot of finger surgery and all of his fingers look to be of equal length, he also wears big rings to hide the fact that the joints would be too close together to be normal.

So I start off by just looking at photos to get some background then if I'm reasonably sure it's a trans then for me I'll use movies I have at home which I can pause at my leisure to get angles and other things, especially finger digit ratio which is supposedly 95% accurate as to original gender.

Other stuff

Who are they with? Have they dated proven trans or suspected trans? This is a huge giveawy because trans obviously prefer other trans as partners, in fact if both still have their intact genitals natural sex is possible although I would think that they have likely been sterilized from the hormones or they take precautions that no conception occurs. These people almost always either have IVF surrogates, ectogenesis and/or adopt. Since they seem to have twins a lot of the time and also are twins themsevles a lot this is strongly indicative of manipulation of the child bearing process by outside personnel, in short an organized and controlled breeding program.

The Transvestigation community: proceed with caution

Check the narrative always even if the information is well researched and accurate. Mr E is a classic example of a trojan horse, interesting funny and cogent comments, entertaining with the music, snappy voice a la TMZ announcer etc But his narrative is about his strange and not supported bible interpretation. He pushes some nephalim idea that comes close to aliens programming. He also gives hypnotic commands at times by constantly repeating the same information. He drops in fallacious and unsupported things about the Catholich Church, either ignorant or wilfully

Walmart

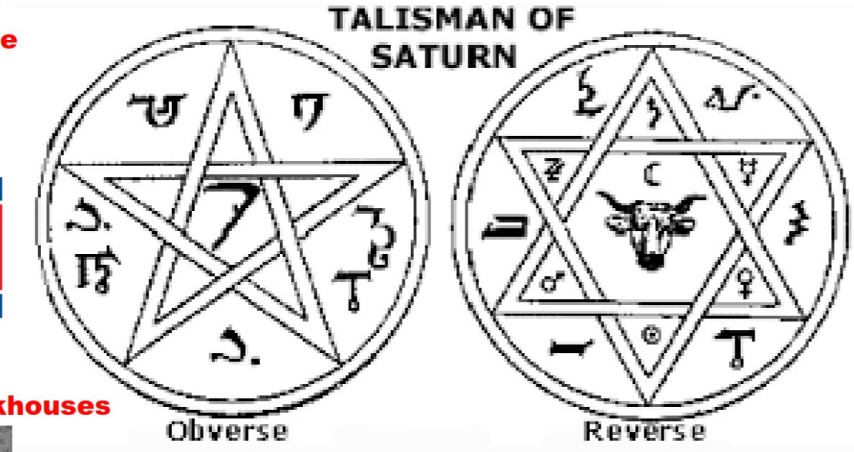
11 men started scottish rite in charleston, sc, 11 is one more than Gods 10, satanism. 11 Jews all over communism etc. 9-11, 3-11, 11-11 etc etc 11, 22, 33, 44, 55, 66, 77, 88,99

Bank of America = 33° Freemasonry

BLUE LODGE MASONs 1-3, outer court
RED LODGE Masons 4+ also hidden higher level ones from dupe masons. 13=Royal Arch 18=Rosicrucian etc
Blue pill or Red Pill?,
Red/White/Blue Masonic colors Satanic Judaeo-Masonic French Revolution

Red Star of Rempham/Moloch-See Acts Ch 7:43, ancient star of the Jews. Communism.

5 Rothschild=Red Shield, 5 Rothschild sons/Bankhouses



Black magic Hexagram of pagan kabbalism from Babylon/India/Egypt, Hermeticism.

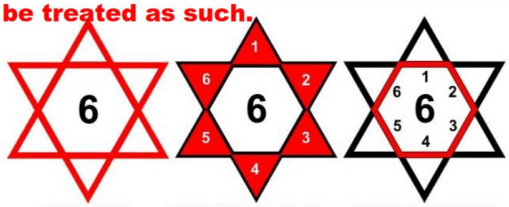
As above so below, 666 encoded. Gnostics star.

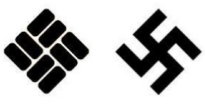
G=7, generation aka sex force worship, Kunalinga, serpent power/sex magic etc "nuthin but a "G" thing, Gatorade...

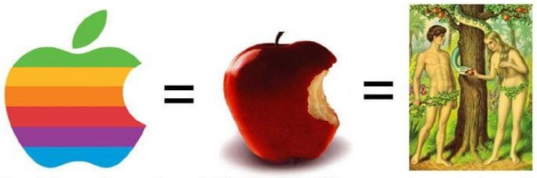
M=13, Mirrored, MM=33 on its side, M&M's, GM, etc

On the 6th Day Man was created, man is only jews according to the Talmud, other humans are animals to be treated as such.

District of-, British-
Columbia Sportswear Company

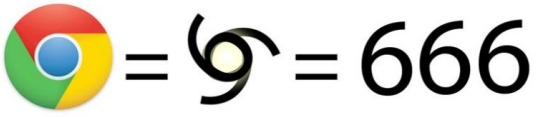






also rainbow colors mocks symbol for God from OT. This is deliberate. Also Josehps coat mocking as well.

knowledge of good and evil



slandering it. He has no references for his ideas on that, everything is in a catechism about the Churchs beliefs but instead Mre takes the jewish line and references jewish media and press. He doesn't trust the press in almsot anything but in that? Nah you have a trojan. He mentions all sorts of things like being circumcised aka jewish, going to concerts and sitting near stars(Beckham), meeting presidents like jimmy carter, lives in some obscure asian country that's full of trans ladyboys on and on. Has a bona fide of being fired for not taking the vax, true or not who knows. He has no idea about Catholic history only what he decides what is correct. For real Catholic history I suggest the works of Fr Denis Fahey, The plot against the Church by Maurice Pinay, St Augustine and other Catholic authors that are at least not the mainstream jewish academia and press.

Another is Eric Dubay. He has good information but then turns around and pushes the same occultism that the people he exposes practice. This is similar to the FE Jeranism's approach except Jeran also slanders the Catholic Church which he supposedly was a member of, more likely he is a crypto-jew and was setup to obey Obamas subliminal command when he made the famous statement about "this isn't the flat earth society" etc Now for Dubay It's all chakras and body energy stuff which is at bottom Kabbalism which came from that region. So the good accurate information is just a vehicle to infiltrate your mind and subvert it. Watch the narrative and conclusions that are either explicitly mentioned or left unsaid.

The others are mainly a mixed bag.

10 Male-to-Female Breast Augmentation and Body Contouring

Thomas Satterwhite and Stelios C. Wilson

Introduction

Gender dysphoria is characterized by marked emotional and social distress caused by a discrepancy between an individual's gender identity and their assigned sex [1]. The care for this patient population requires a multidisciplinary approach [2]. Although not all patients with gender dysphoria require surgical intervention, gender confirmation surgery continues to be recognized as one of the optimal treatments for this patient population [3]. With progressive societal acceptance, public discourse, and improvement in insurance coverage, an increasing number of individuals will seek appropriate care. Thus, practitioners who care for transgender individuals should be aware of the surgical procedures commonly performed.

The World Professional Association for Transgender Heath (WPATH) is an international, multidisciplinary society that establishes the standards of care (SOC) and criteria for medical professional who care for transgender patients [4]. Prior to surgical intervention of transwomen (transgender women), the diagnosis of persistent gender dysphoria is required. Specifically, a referral letter from a mental health professional is required for breast augmentation (compared to two referral letters for genital surgery) documenting legal age, capacity to consent, and appropriately controlled concomitant mental health diagnoses. While not specifically addressed by WPATH SOC, some providers will also require a mental health referral for body contouring procedures. Hormone therapy is often recommended for 1 year prior to gender confirmation surgery. This is especially helpful for breast augmentation to allow for tissue growth and fat redistribution but is not required, especially given that not all patients choose to undergo hormone therapy.

Hormone therapy for transgender woman generally involves both estrogen and anti-androgen medications, like spironolactone [5]. The goal of hormone therapy is to achieve feminization and reduce virilizing effects of endogenous testosterone [5]. Specifically, these medications are used to induce breast development, reduce male pattern hair growth, and alter fat distribution patterns [2]. Unfortunately, these medications have been implicated with increased risk of venous thrombosis, cerebrovascular disease, and myocardial infarctions. However, they have never been shown to elevate cancer prevalence or overall mortality rates [6]. Taken together, hormone therapy with proper physician supervision and

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Table 10.1 Surgical options for transgender women

Chest/breast	*Head and neck*
Breast augmentation	Facial feminization
Body (abdomen, flanks, buttocks)	Thyroid cartilage reduction
Contouring procedures	Vocal cord surgery
	Genital
	Penectomy/ orchiectomy
	Vaginoplasty

when not medically contraindicated has become the standard of care for transgender women [6].

Surgical options for transgender women include, but are not limited to, breast augmentation, vaginoplasty, facial feminization, thyroid cartilage reduction, vocal cord surgery, and body contouring procedures (Table 10.1) [7–10]. For the context of this chapter, we will discuss breast augmentation and body contouring procedures.

Preoperative Care and Medications

A complete history and physical should be obtained. Careful attention should be paid to assess for a history of diabetes, heart or lung disease, immunosuppression or immunosuppressive conditions. For patients seeking breast augmentation, a specific history of prior chest surgery or chest radiation therapy should be elicited. Although there are no clear standards, it is our practice to obtain preoperative mammograms in patients age 40 or older or those with a strong family history of breast cancer. Given the lack of data to support this algorithm and the potentially traumatic experience of going to a mammography center that does not routinely care for this patient population, we only refer our patients to trans-friendly providers and environments. For patients seeking body contouring procedures, any history of abdominal surgery or pelvic radiation should be documented.

In addition, it is important to elicit any possible history of coagulopathy or bleeding disorders. Smoking status should be ascertained, as individuals should be instructed to abstain from all nicotine products for 4 weeks prior to surgery and 4 weeks after surgery. In the author's practice, if there is a concern that a patient continues to smoke, a formal nicotine panel is ordered with standard preoperative labs.

There is evidence to suggest an increased risk of deep venous thrombosis in transgender women taking hormone therapy [2]. In our practice, we educate our patients on these risks, but we do not routinely ask our patients to stop taking these medications in the preoperative or perioperative period. Anecdotally, we have seen a negative emotional and physiologic changes experienced by the patient. However, for extensive body contouring procedures, we may hold estrogen at the time of surgery. We prefer our patients to avoid aspirin and other antiplatelet medications if not contraindicated although this discussion occurs on a case-by-case basis.

Breast Augmentation

Breast Augmentation Background

For transgender women, the acquisition of a female appearance is essential to help ameliorate the incongruity between an individual's gender identity and their assigned sex. A feminine-appearing chest is one of the most obvious characteristics necessary for the transfeminine transition [11]. Thus, it is not surprising that this is one of the first, and sometimes only, surgical procedures that transgender women undergo. Although individuals typically first initiate hormone therapy which induces mammary hypertrophy, exogenous hormone therapy has been shown to have a wide range of responses in male mammary tissue [12]. Thus, the majority of individuals will ultimately need additional volume and contouring. In fact, one group quantified that nearly 70% of the transgender women in their series ultimately underwent breast augmentation [13]. Given that breast augmentation is an operative procedure and caries both short-term and long-term risks, it is important to understand the benefits of the procedure. Studies have confirmed

that breast augmentation in transgender women improves breast satisfaction, and psychosocial and sexual well-being, and is thus a clinically meaningful and medically necessary operation [13, 14].

Differences in Male and Female Chests

There are notable anatomic differences between male and female chests, many of which cannot be overcome with current breast reconstructive procedures. Males tend to have wider chests with great distances between nipple-areolar complexes (NACs). This will lead to a tradeoff between medial fullness and NAC placement during augmentation. In most cases, the implant is centered behind the NACs. Patients should be counseled that this could cause more laterally displaced nipples than the average female patient. In addition, the wider sternum will also allow for limited cleavage in most transgender females. The implant can be positioned slightly more medial to attempt to correct this finding as long as the patient understands that her NACs will be even more laterally displaced. Although fat grafting to the medial breasts after augmentation can help smooth and fill the medial breast, transgender women may not be able to obtain sufficient feminine cleavage. This must be discussed if their goal is to be able to wear low-cut clothing. To help camouflage, the use of certain "push up" bras can elevate the breasts medially to help narrow the cleavage while wearing clothing. Taken together, the patient must be aware of these limitations prior to proceeding with augmentation.

In addition, there are also differences between male and female NACs with men having smaller, more ovoid areolas compared to round, feminine areolas [15, 16]. In our experience, male nipples tend to become rounder once the overlying tissue is placed on stretch from the underlying prosthesis. If a patient is still unhappy with their NACs following augmentation, tattooing can be performed to help create larger, rounder areolas.

Breast Augmentation Preoperative Assessment

As previously mentioned, the WPATH SOC recommends at least one referral letter from a mental health professional prior to chest/breast surgery (Table 10.2) [4]. While some argue that this requirement places undue strain on individuals during an already stressful process, it is important to adhere to current WPATH SOC guidelines and request appropriate medical-legal documentation [17, 18].

After an appropriate referral letter has been obtained and patients are compliant with the surgeon suggested feminizing hormone treatment, the patient is ready for surgical planning. All aspects of the procedure should be explained and the patient should be properly educated. Specifically, the patient should be walked through the preoperative, perioperative, and postoperative courses.

In addition to medical preoperative assessment, standard breast measurements should be performed including breast base width, nipple to inframammary fold (IMF) distance, and both upper and lower pole pinch test. Asymmetries should be pointed out to the patient with the explanation that any underlying asymmetries of the chest, breast, or nipples will likely be accentuated by a breast augmentation procedure. The patient should understand the risks of this proce-

Table 10.2 The WPATH SOC recommends a referral letter containing the following

1. The client's general identifying characteristics.
2. Results of the client's psychosocial assessment, including diagnoses.
3. The duration of the mental health professional's relationship with the client, including the type of evaluation and therapy or counseling to date.
4. An explanation that the criteria for surgery have been met, and a brief description of the clinical rationale for supporting the patient's request for surgery.
5. A statement that informed consent has been obtained from the patient.
6. A statement that the mental health professional is available for coordination of care and welcomes a phone call to establish this.

dure that include, but are not limited to, postoperative pain, loss of nipple sensation, hypersensitivity, hematoma, seroma, infection, asymmetries, implant malposition or rupture, capsular contracture and need for revisionary procedures both in the short term and the long term. Ultimately, the patient will need to understand that this procedure will not necessarily resolve gender dysphoria, but can improve it.

Most of the preoperative decisions regarding implant pocket location, implant type and size, optimal location of the IMF, and incision location are based around well-cited articles from the esthetic surgery literature [19–21].

In general, our patients will most often have minimal glandular tissue, even after 1 year or more of hormone therapy. We have found that we rarely have greater than 2.0 cm of tissue thickness in the upper pole. In addition, we often do not have greater than 0.5 cm of tissue at the IMF. Based on the these measurements, we find it necessary to do a true subpectoral reconstruction in the majority of our patients [19]. While the pectoralis major is thicker than that generally found in women, we have found this pocket location to yield both safe and reproducible results.

While many types of implants have been described, our team prefers to use silicone gel form-stable implants. We use these implants in a similar fashion as they have been described in the literature [22]. Given the lack of overlying breast tissue in transgender women and our patient's preference for natural appearing breasts, we have found continued success using these prosthetics. Overall, the surgeon must still assess each patient's preferences, expectations, and goals when deciding on specific implants. Based on our patient population, it would not be unusual to have a base width greater than 15 cm with a relatively short, constricted IMF that can be reconstructed in a natural way using low- or moderate-profile anatomic silicone gel devices. Based on the authors' experience, the relatively tight pocket in the majority of patients makes high-profile implants suboptimal. Ultimately, the size of the implant will be based primarily on the patient's breast diameter. With the short nipple to IMF distance and a very tight lower pole, the IMF will typically need to be lowered based on the aforementioned characteristics for optimal results [19].

Prior to surgery, the patient is a marked in the following fashion (Fig. 10.1). First, the chest midline is marked. Next, each of the native IMFs is marked. The breast diameters are confirmed to ensure proper implants are available prior to starting the operation. A 3 cm zone is clearly marked between the base markings over the sternum that is not violated as a way to preserve the medial breast architecture and prevent medial implant migration and symmastia. As previously mentioned, the IMF will likely need to be lowered given the larger base diameters found in transgender females and their short nipple to IMF distance. Using a combination of the base diameter, pocket stretch, and native IMF, a new IMF can be calculated and marked accordingly [19].

Breast Augmentation Surgical Approach

There are many techniques described for both primary breast augmentation and implant-based breast reconstruction. Unfortunately, there is much less available describing breast augmentation in transgender women. In this section, we will describe the technique commonly used by the senior author that is a combination of the aforementioned research and years of clinical experience.

Once in the operating room, cefazolin is dosed in a weight-based manner and readministered per previously described guidelines [23].

The patient is brought into the operating room and a time out is performed confirming the correct patient, site, operation, preoperative markings, and equipment necessary. The patient is then placed supine on the operating table with arms abducted to 90 degrees. Kerlex is used to circumferentially wrap the arms to the arm boards once it is confirmed the patient's hips are situated over the flex in the bed; both measures taken to allow the patient to sit up for intraoperative assessment. The patient is then secured and grounded, and proper deep venous thrombosis

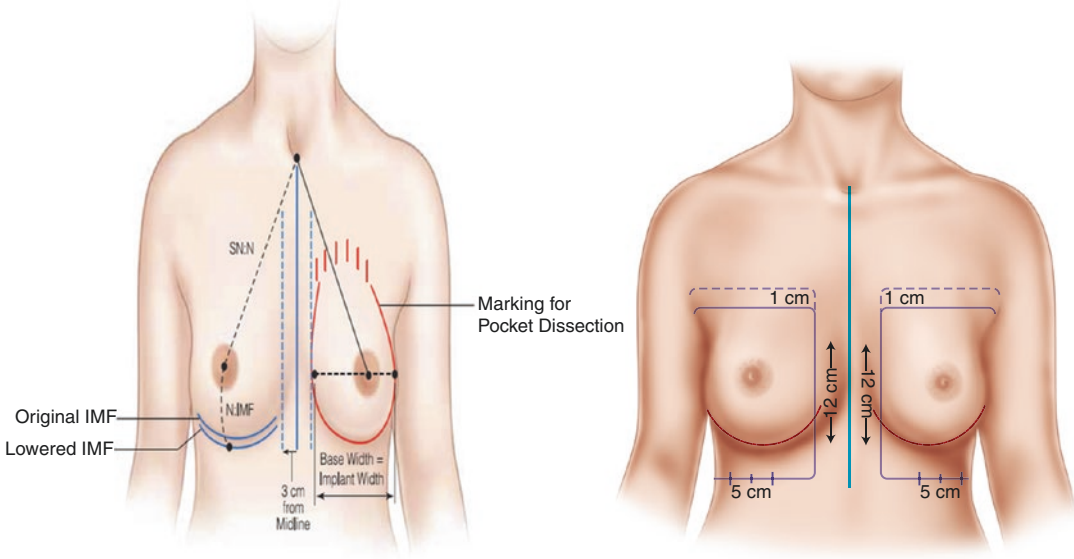

Fig. 10.1 Standard breast augmentation preoperative markings

prophylaxis is initiated [24]. If not medically contraindicated, we typically prefer to perform this procedure under general anesthesia.

After induction of anesthesia, the patient is prepped with chlorhexidine from the umbilicus to the base of the neck. Local anesthesia is infiltrated as a field block in the location of the inframammary incision. The patient is then draped in the standard, sterile fashion. Semiocclusive dressings are used as nipple shields over the entire areola to prevent possible bacterial contamination [25].

The 5 cm access incision is made at the level of the new IMF which, in most circumstances, will need to be below the native IMF (Fig. 10.1). In general, this incision and subsequent dissection should not occur below the new IMF as this will weaken the lower support of the implant and may predispose a patient to implant migration and/or double bubble deformity [22]. In the authors' experience, patients will tolerate an incision that rides up slightly onto the breast mound much better than one below the chest that will be visible in a bathing suit or brassiere.

Once through the skin, dissection is performed with electrocautery through the subcutaneous tissue to the pectoralis fascia. Dissection is continued below the pectoralis major with the help of a lighted retractor. Care is taken to dissect a pocket to the exact dimensions of the previously chosen implant as to avoid possible implant migration or rotation. Once the pocket is properly defined, hemostasis is attained and the pocket is irrigated with triple antibiotic solution as previously described [26].

While the preferred implant is generally chosen during the preoperative consultation, occasionally there is some degree of uncertainty leading to intraoperative surgeon discretion. For these instances, saline or gel sizers can be used. If sizers are utilized, care must be taken to insert and remove these sizers carefully to prevent over dissection of the pocket. In addition, the surgeon should be critical of the skin envelope and tension on the medial breast borders that may predispose a patient to medial migration and symmastia. In rare instances, mildly relaxing the lateral pocket will help accommodate a larger implant without placing unwanted forces medially, but overall, the size of the implant will more likely be limited by the skin envelope.

A Keller funnel is typically used for insertion, since implants can be relatively large. Although not typically performed in our practice, a 3 point fixation stitch with 3.0 PDS may be used to tack Scarpa's at the level of the new IMF to the chest

wall to prevent downward migration of the implant. The wound is then closed in layered fashion using 3–0 monocryl for the Scarpa's layer and the deep dermal layer and 4–0 monocryl for the subcuticular closure. Steristrips are placed over the incision and then a semiocclusive dressing is placed.

Breast Augmentation Postoperative Care

At the conclusion of the procedure, a circumferentially placed ace-wrap is used for compression. When not medically contraindicated, this procedure is performed in the outpatient setting with the patient being sent home several hours after the procedure. The patients are instructed to keep the ace-wrap and incisions dry until follow-up in 5–7 days. At follow-up, the patients are instructed to wear a sports bra for the next 4–6 weeks. During this time, strenuous activity should be avoided to prevent implant migration. Patients are instructed to abstain from reaching, pulling, or lifting anything heavier than a gallon of milk during this time. At 3 weeks, the steristrips have generally fallen off and the patients are instructed to massage the scars with silicone-based cream to attempt to minimize hypertrophic scarring. Typical long-term results are seen in Fig. 10.2.

Breast Augmentation Complications

It is difficult to quantify complications in breast augmentation in this specific patient population. Instead, we defer to the cosmetic surgery literature to give our patients a sense of the likely risk profile. Specifically, we mention the risk of capsular contracture, hematoma, seroma, rupture, infection, scarring, and NAC sensation changes [27]. We also mention the reported but very low risk of breast implant-associated anaplastic large-cell lymphoma (ALCL) [28]. Needless to say, research is needed to more accurately quantify risk for transgender women undergoing breast augmentation.

Breast Augmentation Postoperative Considerations

As previously mentioned, there have been no associations between hormone therapy and cancer risk or mortality [6]. Still, we recommend our patients to follow national guidelines for breast cancer screenings following breast augmentation in addition to gender-specific medical maintenance [29]. Given that our patients may undergo reconstruction with textured silicone devices, we educate such patients on the signs and symptoms of ALCL and stress the importance of regular MRI surveillance for rupture starting 3 years after reconstruction and every 2 years thereafter.

Breast Augmentation Additional Approaches

While our results have been promising based on one-stage implant-based augmentations, there may be a utility for a two-staged approach with tissue expansion. In our practice, we have yet to encounter the need, but, in theory, this strategy could be beneficial for patients with thin skin and subcutaneous tissue, little breast parenchyma, and a hypertrophied pectoralis major. Fat grafting can be considered for patients who are averse to implants and are content with having only modest gains. Also, fat grafting may prove to be a powerful adjunct for this patient population, especially when attempting to create more cleavage in wide-chested individuals.

Body Contouring

Body Contouring Background

For many transgender women, gender confirmation surgery involves not only breast augmentation, but also feminization of other aspects of their body. One of the other areas of recent interest in this population's transition is body contouring with specific attention being paid to the abdomen, flanks, hips and buttock

regions. As previously mentioned, estrogen and anti-androgen therapies stimulate growth of mammary tissue. In addition, these therapies have an effect on other tissues throughout the body. Specifically, estrogen is thought to deposit adipose tissue preferentially in the gluteofemoral region while testosterone is thought to stimulate adipose deposition in the abdominal region [30]. MRI evidence of transgender men and women has confirmed these changes in early as 12 months after initiating hormone therapy [31]. Still, even with hormonal therapy, there are marked differences between transgender women and cisgender women, some of which can be ameliorated with body contouring procedures.

Fig. 10.2 Breast augmentation before and after

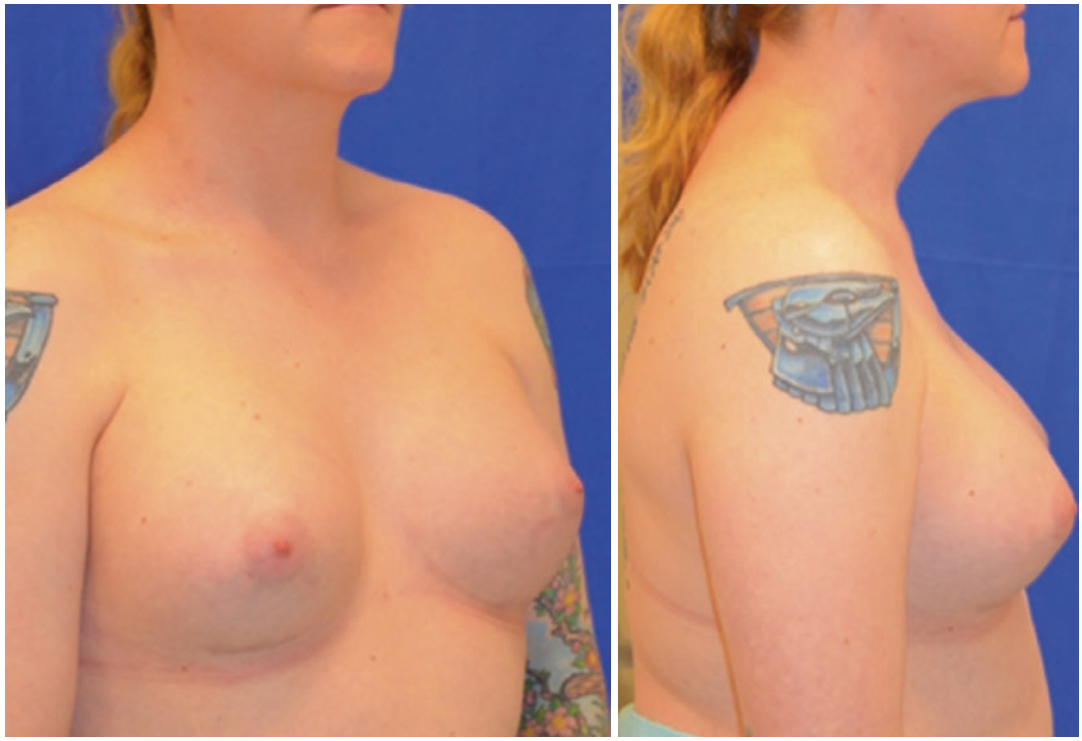

Fig. 10. 2 (continued)

Differences in Male and Female Body Habitus

Fat distribution in humans is a multifactorial process with general trends for both age and genetic sex. The iconic representation of the ideal female body as having an "hourglass" figure has withstood the test of time (Figs. 10.3 and 10.4) [32]. Some argue that the evolutionary psychology that an hourglass figure offers important favorable biologic information to potential mates regarding a woman's reproductive potential [33]. A widely used anthropometric measurement technique to discuss the narrowest point between the iliac crests and the base of the ribs (waist) and the widest portion at the level of the buttocks (hip) to calculate a waist-to-hip ratio (WHR). The basis of this measurement is based on combination of adipose quantity, adipose deposition patterns, and underlying bony architecture.

During infancy and early childhood, fat distribution patterns are very similar for both men and women. After puberty, men tend to undergo an android fat distribution pattern with increased volume of both intraabdominal and subcutaneous fat of the abdomen and flanks [34]. In contrast, women tend to undergo a gynoid fat distribution with lower levels of fat deposited in the abdomen and a greater amount in the gluteal region and hips [34]. The typical range of WHR for healthy young adult women has been shown to be 0.67–0.80 compared to healthy young men with a range of 0.85–0.95 [35]. Interestingly, following menopause, the WHR of women becomes closer to that of age-adjusted male counterparts [36]. Although somewhat subjective, many studies looking at both contemporary cross-cultural and historic artistic representations mention an ideal WHR to be approximately 0.7 [32]. One review looked at studies that analyzed everything from recent playboy centerfolds to ancient Greek and Egyptian sculptures as evidence to support this claim [32]. Taken together, body contouring in transgender females should aim to better establish this ratio.

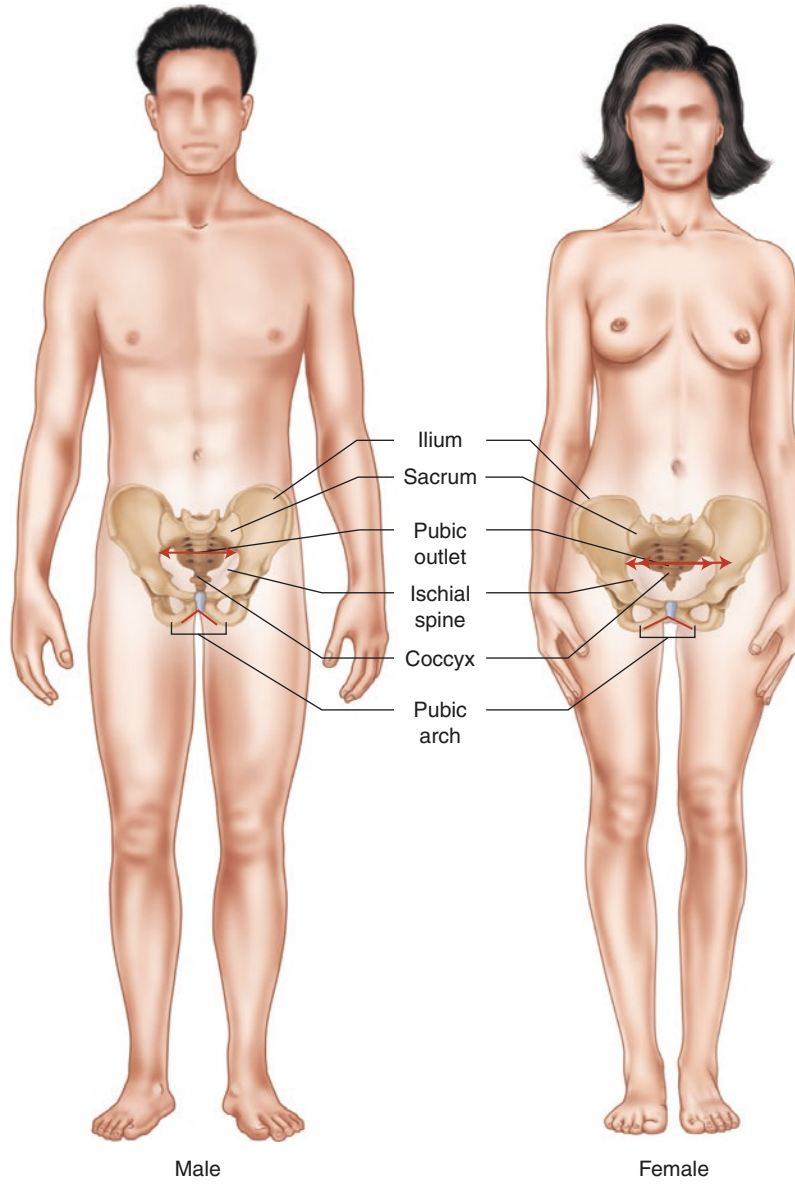

Fig. 10.3 Difference in female and male boney structure. In general, women have more obtuse subpubic c angles, wider pelvic brims, and flared iliac crests

There are also differences in male and female gluteal forms. Gynoid bodies tend to have more adipose deposition in the gluteal region with a distinct transition from the lower back. Also, the mid-lateral portion of gynoid buttocks tend to have a fuller, rounder, shape while a defining characteristic of the android buttock shape, not to be diminished with regard to goals of this procedure, is that the mid-lateral portion of the android buttocks can be flat or even have a distinct concavity (Fig. 10.4).

Finally, there are differences in male and female pelvises. Overall, there are few characteristics of the bony architecture that helps strengthen the aforementioned differences in WHR between men and women. Women have more obtuse subpubic angles, wider pelvic brims, and flared iliac crests (Fig. 10.3) [37]. Unfortunately, it is unlikely that the bony architecture will remodel in any meaningful way with hormone therapy and surgical reconstruction would be excessively morbid. Thus, any

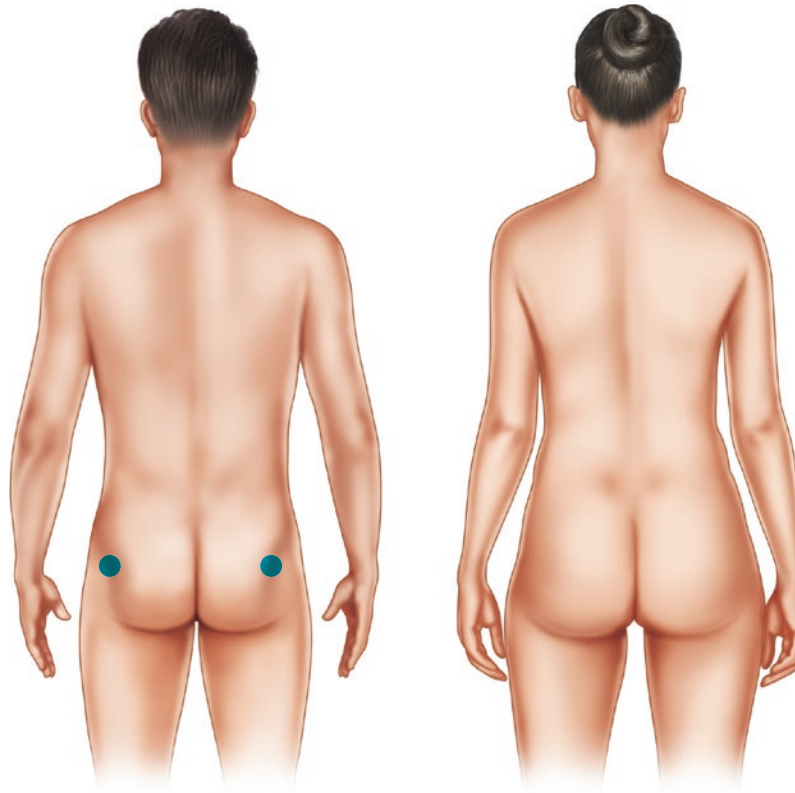

Fig. 10.4 Difference in female and male gluteal forms. In general, gynoid bodies tend to have more adipose deposition in the gluteal region with a distinct transition from the lower back. In addition, the mid-lateral portion of the android buttocks tends to be flat or even has a distinct concavity

alteration to camouflage these differences will have to occur with soft tissue reduction and augmentation.

Body Contouring Preoperative Assessment

Unlike traditional body contouring procedures following massive weight loss or pregnancy-associated changes, body contouring for transgender women requires special consideration. Our authors recommend waiting to perform these procedures until at least 1 year after initiating hormone therapy and after obtaining preoperative evaluation and documentation from a mental health professional as per WPATH guidelines [4]. All aspects of the procedure should be explained, and the patient should be properly educated. Specifically, the patient should be walked through the preoperative, perioperative, and postoperative courses. In addition, a careful preoperative history and physical as previously described should be performed.

It is important for the patient to be aware of the differences in male and female body types (Figs. 10.3 and 10.4). This understanding will allow the patient to appreciate the individualized starting point, the goals, and the limitations of body contouring. Body contouring in transgender females will be a balance between skin elasticity and contour discrepancy. Ultimately, we will not be able to change the underlying bony architecture. Instead, the surgeon must try to feminize the body form by attempting to establish as much of a waistline as possible and to improve the shape and proportions of the buttocks and hips. Commonly, lipodystrophy occurs in all individuals but certainly in transgender women, which results in a waistline that is usually considerably higher than desired. Simply lowering this waistline makes significant improvements in contour and overall shape. This will be especially important for transgender women who seek to fit into

female clothing that often accentuates this type of waistline.

In general, the amount of lipoaspirate obtained is the limiting factor for body contouring procedures in this population. Thus, preoperative and intraoperative decisions on how to best utilize the injectable fat are critical. With a sometimes-limited volume of fat to graft, it is important to have esthetic priorities for the use of available volume. In the authors' opinion, the most important possible improvements in descending order would be:

1. To establish as uniform and properly low waistline as much as possible, and along with this goal, to accentuate the curvature and improve the transition zone better the lower back and the upper buttock area.
2. To improve the shape and roundness of the mid-lateral buttocks which in androgenic bodies is commonly flattened or even concave.
3. To improve the transition between the buttocks and the hips to create width and fullness that is more characteristic of a gynoid silhouette.
4. To improve the overall size, projection, and upper fullness of the buttocks.

Prior to surgery, the patient is marked in a way to have an organized plan addressing these improvements. The surgeon sits in front of the patient with the umbilicus at eye level. A line is then made at this level in a horizontal fashion out toward the flanks bilaterally. The patient is then asked to turn 180 and the lines are continued to the center of the back. Ultimately, this is the area where the surgeon will be most aggressive in attempting to establish and new, generally lower, waistline using liposuction. The aggressiveness of lipoaspirate yield will be tapered into the surrounding areas.

The next marking is a shadow in the mid-lateral buttock area, which is often concave in transgender women. Our system utilizes crosshatch pattern markings in the areas of concern as a way to clearly define where volume is needed. In our experience, deficiencies in this area are most easily identified on posterolateral oblique view.

The final marking is performed on the superior portion of the buttocks to establish the inverted upper heart shape curvature to the superior and mid buttocks. Unfortunately, there are limited landmarks in this region. In patients with visible dimpling in the parasacral area, a line can be drawn from each dimple to the superior most portion of the gluteal cleft creating a V. These lines can then be smoothed out and continued in a parabolic way to define a round and symmetric superior pole. In addition to adding volume to the area below the markings, liposuction can be performed above the sacrum (above the marked V) and above the lateral markings to better define this transition.

Body Contouring Surgical Approach

There are many techniques described for body contouring with liposuction and for gluteal augmentation with fat grafting. Similarly to breast augmentation, there is much less available describing these techniques in transgender women. In this section, we will describe the techniques commonly used by the senior author.

In the holding area prior to surgery, the patient is marked as previously described. The patient is then brought into the operating room and started in the supine position. After the skin prep, draping and time out, access incisions are planned and tumescent fluid is infiltrated using a tumescent cannula followed by a waiting period of 20 minutes for the local anesthesia to take effect. Power-assisted liposuction (PAL) is performed under low pressure of 10–20 mmHg and a combination of liposuction cannulas. For trunk liposuction, we will frequently use 3, 4, and 5 mm cannulas with both Mercedes and a basket tips (also known as the birdcage) with larger cannulas being used in deeper planes and basket tips being particularly effective in the more fibrous areas of the lower back and posterior flanks. Fat is collected in a 500 mL assay bottle prior to processing.

Once the anterior surface is sufficiently contoured, all stab incisions are closed using 5–0 fast absorbing gut sutures and sterile dressings

are placed. The patient is then carefully flipped to the prone position. The process of tumescent and liposuction are then repeated on the posterior surface. Once the posterior surface is sufficiently contoured, the lipoaspirate is then poured in a sterile fashion into a stainless steel sieve. A wooden tongue depressor is used to gently mix the lipoaspirate to allow faster straining. Once strained of all excess tumescent fluid and blood, the fat cells are washed by pouring sterile saline into the sieve and again allowing for the fluid to strain. This process is repeated two times, or until all gross blood has been removed. The residual filtered fat is then loaded into 20 mL syringe.

Fat grafting is then performed to address, in the aforementioned priority, the previously described deficiencies. Specifically, a combination of 3 mm by 20 cm blunt-tipped cannulas (for superficial injections) and a 3 mm by 15 cm blunt-tipped cannula (for intramuscular injections) is used. Depending on the access incisions used during liposuction, we can often use the same access for fat grafting. In general, we need at least one incision in the sacral region, one in the upper outer buttocks adjacent to the hips and one in each infragluteal crease, which our team tends to place several centimeters lateral to the midline of each buttock as this is where we have found to have the most control grafting both the mid-lateral gluteal region and the hips.

Fat grafting is performed slowly and cautiously using only 0.5 mL amount across the entire length of the retreating cannula as it is moved outward through all layers of the tissue to be grafted. We only inject when the cannula is being actively moved, and only on the withdrawal portion of cannula movement, to reduce the degree of intravascular fat injected should the cannula enter a blood vessel lumen during a portion of its trajectory. Grafting is performed in the deep plane first if possible, but if there is a very limited supply of fat, we sometimes will start in the superficial plane where it is most efficient at creating contour. In general, all injections should be performed with a blunt-tipped cannula with the cannula parallel to the operating table or aimed superficially to avoid potentially dangerous complications.

Once satisfied with the patient's contour or, more likely, when all fat has been used, all stab incisions are closed using 5–0 fast absorbing gut sutures and sterile dressings are placed.

Body Contouring Postoperative Care

At the conclusion of the procedure, the patient is placed in a compression garment. At this time, there are no garment manufacturers that produce female body shape garments with the additional genital opening for transgender women who have yet to undergo penectomy/vaginoplasty. For the sake of patient comfort and compliance, we typically use a male compression garment.

As with any body contouring procedure, it is imperative for patients to ambulate as quickly as possible. Patients are also told that we want them to move their ankles back and forth "like stepping on a gas pedal" constantly when they are not sleeping or walking during the first 7 days after the surgery. Though anecdotal, we believe this coaching may have played a role in our not having seen a DVT or PE in a body contouring procedure to date.

One of the challenges for patients with fat grafting to the buttocks is the restriction in placing their body weight on the grafted areas. This can be especially challenging in transgender women because fat grafting is performed not only in the buttocks but also on the bilateral hips. In these instances, the patients must not sit directly on their buttocks and they must sleep on their abdomen to avoid pressure to the buttocks or hips. This management can be further complicated when patients wish to have a breast augmentation at the same time as the fat grafting procedure. In these instances, we prefer patients to sleep on their sides and to try to turn from side to side as frequently as logistically possible throughout the night. After 2 weeks, patients can sit directly on their buttocks and can sleep without pressure restrictions. Typical long-term results are shown in Fig. 10.5.

Fig. 10.5 Body contouring before and after

Body Contouring Complications

At this point, it is difficult to quantify complications for body contouring performed specifically for gender confirmation purposes. Instead, we defer to the cosmetic surgery literature to educate outpatients on potential risks. For the liposuction portion of the procedure, we explain the risks of skin surface irregularities and possible pigments changes, especially given the aggressiveness in liposuction to obtain optimal results.

For the fat grafting portion of the procedure, we explain that a portion of the fat will survive and that this value changes based on both patient characteristics and on the avoidance of postoperative pressure to the grafted areas. With proper postoperative compliance and use of the micro fat grafting technique of 0.5 cc per passage of the cannula length, we experience an 85% maintenance of the injected fat volume long term. In addition to variable graft survival, the patient must understand the risk of gluteal asymmetry, fat necrosis, hematoma, oil cyst formation, infection, seroma, postoperative bruising, DVT, and the rare but possible need for blood transfusion.

Further, the patient should be aware of possible injury to the sciatic nerve and also should be educated on the reported complication of fat embolism. Our technical approach attempts to minimize the risk of these rare, but serious complications. Needless to say, research is needed to more accurately quantify risk for transgender women undergoing body contouring procedures.

Body Contouring Special Considerations

As previously mentioned, the total amount of fat grafted varies widely between individuals, and especially in our demographic, it is not uncommon for healthy, fairly athletic individuals to have no more than 200 mL per side for us to use as concentrated fat graft. This is why it must be used so judiciously. These challenges underscore the importance of going into the operation with clear goals and objectives. While liposuction will ultimately help with the waistline and the transition between the lower back and the upper buttock, we may only have enough fat to treat one or possibly two areas of concern. For a slender individual with only flank lipodystrophy, we often only have enough fat to address the concavity in the mid-lateral buttock region. In the minority of

cases, we are also able to address the hips. In larger patients with circumferential subcutaneous trunk excess, we commonly have enough fat to improve upon size, projection, and upper fullness of the buttocks.

These potential volume limitations should be conveyed to patients at the preoperative consultation as to set realistic goals and expectations.

Conclusions

Breast augmentation and body contouring are powerful tools for transgender women seeking gender confirmation surgery. While most of our current techniques are based from studies reported in the esthetic surgery literature, these patients require special considerations. In addition to highlighting our surgical management, we hope that this chapter brings to light the challenges and limitations of these procedures.

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The Importance of Facial Gender Confirmation Surgery

11

Jens Urs Berli and Eric Plemons

Secondary Sex Characteristics and Their Role in Gender Dysphoria

To distinguish the phenotypic sex of a newborn, observers typically inspect the primary external genitalia and pronounce the child female, male, or intersex. As a result of exposure to increased gonadal hormones during puberty, a number of secondary sex characteristics develop (Table 11.1). These include the development of patterned body hair, the presence or absence of breasts, change in muscle mass, and differentiation of the skeleton, including the face and skull. Taken together, secondary sex characteristics are the visible signs of bodily sex; they influence how each of us understands our own sexed embodiment and how others see us in sexed and gendered categories, as well. A person whose gender identity is incongruent with his/her sex characteristics can experience gender dysphoria.

Since the earliest formulation of gender dysphoria as a medical disorder in the 1950s, a person's bodily sex was determined by the primary genitalia. *Transsexualism*, as the diagnostic entity was known at the time, was conceived as a mental health dysfunction best treated through endocrine supplementation and surgical reconstruction of the genitalia. This was the "sex" that "sex reassignment surgery" was intended to alter [1, 2]. It was a definition of sex that focused narrowly genital aspects of the patient's body.

Contemporary transgender care emphasizes a consideration of the individual patient's experience of dysphoria rather than asserting a course of treatment or definition of *sex* or *gender* from a clinician's point of view. The patient-centered approach takes seriously patients' understandings of their gender dysphoria and their goals for medical transition. First emerging in the USA in the 1990s, two decades of patient-centric care has demonstrated that rather than a narrowly defined genital or endocrine issue, gender dysphoria can be associated with any or all of the sex or gender markers of the body in varying degrees of severity throughout the life course [3]. A shift from clinician- to patient-centered approach has also demonstrated that rather than individual psychological distress associated with discrete body parts – as early formulations of *transsexualism* once had it – the majority of transgender-identified individuals identify social stigma, social exclusion, and mistreatment as their main cause of suffering [3].

The US 2016 National Transgender Discrimination Survey revealed that 50% of respondents were harassed on the job, 20% lost

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Table 11.1 Secondary sex characteristics

	Male	Female
Face	Square	Oval
Hairline	M shaped; alopecia	O Shaped
Osseous structures	More pronounced	Smoother, more childlike
Soft tissues/Skin	Coarse	Fine
Facial hair	Abundant/coarse	Rare/fine
Musculoskeletal system	More bulk, larger, more pronounced skeletal system. Larger hands/feet	Less muscle mass; less bone mass; smaller hands/feet
Fat	Truncal distribution; higher body fat	Pelvic distribution; lower body fat
Vocal cords/Thyroid cartilage	Larger	Smaller
Height	Higher	Shorter
Eccrine/Apocrine glands	Higher secretion	Lower secretion
Breast gland	Minimal enlargement	Breast growth
Body hair	Proportionally higher in any given ethnicity	Proportionally lower in any given ethnicity

or were denied housing due to their gender identity, and 78% of trans students were harassed or assaulted [4]. Other studies confirm similar findings [5, 6]. These negative effects are disproportionately experienced by people whose bodies display sexed characteristics seen to be at odds with their gender presentation. It is not *being* a transgender person that results in harassment on the street, for example. Negative and sometimes violent attention comes from having a gender-nonconforming appearance [5, 7]. This fact makes the value of facial gender confirmation surgery (FGCS) clear.

Impact of Facial Gender Confirmation Surgery

Facial features are among the most recognizable of the secondary sex listed in Table 11.1. They are visible to others in social life and to patients when they look in the mirror. Facial features are also among the hardest secondary sex characteristics to alter or camouflage. While the importance of facial appearance is frequently regarded as common sense, its value for social sex determination is not reflected in current standards of care for transgender patients. The WPATH Standards of Care (Version 7) defines facial surgery as an auxiliary procedure to medical transition, a process whose surgical components focus on chest and genital reconstruction [8]. This categorization affirms that for the WPATH and the many medical, professional, and advocacy groups who depend on its Standards of Care for guidance, chests and genitals are the most important sites of sexual difference and all other aspects of the sexed and gendered body are auxiliary to them. This is not how any of us experiences sexed and gendered bodies however – our own or anyone else's. While the surgical prioritization of chests and genitals certainly reflects the preferences and experiences of many transgender surgical patients, it is also the case that the focus on these body parts bears the legacy of the *transsexual* diagnosis and its associated clinician-centric treatment philosophies. These represented a very narrow understanding of what prospective patients wanted from surgical intervention [9–11].

In its current form, the SOC leaves open the therapeutic status of FGCS by acknowledging that in some circumstances, facial procedures may be considered "medically necessary" rather than cosmetic. This vague definition does not reflect the daily experience of individuals whose facial appearance makes them subject to discrimination and harassment, nor those who locate the source of their dysphoria in the distinct and visibly sexed features of their face [5, 6, 12, 13].

As a procedure that alters the sex signifiers of the face, facial gender confirmation surgery

(FGCS) aims to transform the social recognizability of the patient. It affirms sex as a social identity by intervening in the social body. We adopt the term FGCS here as a way to acknowledge that the set of procedures aims to confirm a patient's gender identity. Combining bone and soft tissue procedures, FGCS is a powerful means to alleviate internal and external gender dysphoria, and its efficacy has been confirmed in a variety of studies [14–16].

Except for select case reports and experience by individual providers, the vast majority of FGCS practice and literature focuses on feminizing the face and skull rather than masculinizing it. This is not a surprise since the range of facial structures that are recognized as acceptably masculine or plausibly male is far wider than those recognized as acceptably feminine or plausibly female. As a result, though not exposed to the masculinizing effects of testosterone during puberty, trans men's faces are more frequently recognized by the man himself and by others to be sufficiently masculine such that surgery is unnecessary. This is especially the case if facial hair is present. As techniques improve and healthcare coverage expands, demand for masculinizing procedures may increase in the future [17]. Trans women whose faces were changed significantly during puberty – widened jaw, larger nose, more prominent chin and forehead, pronounced thyroid cartilage, and male-pattern hairline – often find that these features render their faces implausibly female to those around them; others see their facial features as a reflection of their male bodily history. Frequently, these women also feel personal dissatisfaction and dysphoria due to their facial features.

FGCS intervenes in sex not solely as a property of the patient's body but also as an identity produced through social interaction and recognition. When others in social life recognize a trans woman as female and treat her as such, her identity as a woman is confirmed. This confirmation constitutes the therapeutic value of FGCS as a treatment for gender dysphoria. To understand FGCS as medically necessary, we must take the effects of social recognition as seriously for transgender patients as we do for other non-life-saving reconstructive surgery such as that for cleft lip and burn reconstruction, for example. Put simply, it matters how we look to others.

While certainly not all negative social interaction associated with gender nonconformity can be prevented by FGCS, early research has shown that it can make a significant improvement in the daily lives of some trans women [15, 16, 18–20]. Validated patient-reported outcome surveys are needed to further bolster the evidence [21].

Historical Aspects of Facial Gender Confirmation Surgery

FGCS was first developed in the 1980s, when San Francisco-based surgeon Dr. Douglas Ousterhout was presented with a patient who had undergone genital reconstruction surgery but was still recognized by others as male. She wondered if a procedure existed that could feminize her masculine face. At the time, as a surgical category, "the female face" did not yet exist. Finding no guidance from the surgical literature, Ousterhout created his models of sexed facial structure from anthropological research and the metrics of a longitudinal craniofacial growth study from the early twentieth century. Based on these models, Ousterhout developed a set of procedures to transition the patient's masculine face into a feminine form [22]. His initial focus was on bone reconstruction of the chin, nose, and forehead, and soft tissue modifications of the thyroid cartilage and hairline. He termed the set of feminizing procedures "facial feminization surgery" (FFS), and it remains commonly known as FFS in most medical literature.

Administrators of European gender clinics began incorporating FFS into their holistic healthcare programs for trans women in the late 1990s [23–25], and a growing number of clinicians from around the world now name avoiding facial reconstruction as one reason to start young trans girls on testosterone blockers before pubertal bone structure changes begin [26–30].

Patient Perspective

The following section expands on the accounts of trans women the authors have witnessed either in direct patient interaction (JB) or during ethnographic research (EP). FGCS patients frequently reported that they choose to undergo facial surgery either before or in lieu of genital or chest reconstruction. This prioritization reflects the value of the impact FGCS will have on their lives – despite the fact that it is often far more expensive than other procedures and only rarely covered by insurance. One patient explained simply that she wanted FGCS so that when she "went into a grocery store, the person would say," "Can I help you, Miss?" "That's really what I want," she said. "I want to be read as, accepted as, and reacted to as a woman." Another patient explained that no matter what chest or genital anatomy she had going into the operating room, when she came out with a new face, she would finally be a woman. Others asserted that they wanted to look at themselves in the mirror and see a woman looking back at them. Without being accepted by others as a woman, one patient argued, she would never have taken on the requirement to "live as her preferred gender" (formerly known in the SOC as the Real Life Test). "How could I live as a woman," she asked exasperatedly, "when everyone saw me as a man?! When I found out about FFS it was like a Christmas present in my world," she said. "You can do a lot of things but if your face doesn't reflect – not only to society but probably even more to myself – the gender that I want to present in, really I personally thought that transitioning in any other way would be kind of useless. If I'm going to transition, I need to have FFS. It's that simple" [13].

Ethnographic research also supports the findings commonly reported in surgical literature that FGCS patients are generally pleased with the results of their procedures. The other author's (JB) experience working with trans female patients confirms the above statements. Patients with low incomes who in the current healthcare landscape have access to other affirming procedures are often stranded in their transition process. In individual circumstances, this may leave the patient more vulnerable than they were pre-transition. A patient reported that until her facial features could be altered, she would not be willing to socially transition out of fear for her personal safety and discrimination. In her example, the lack of access to FGCS prevented her from living her authentic self and receiving the medical and surgical care she needed.

Even more disconcerting is the example of a patient wanting to detransition due to the obvious effects of unwanted societal recognition and all its sequelae making it safer for her to return to her pre-transition anatomy.

Current Evidence and Controversies

There is strong evidence confirming that gender-affirming care can decrease psychosocial sequelae of gender dysphoria [7, 8]. In their study of cost per quality-adjusted life year (QALY) in the US population [31], Padula et al. found that despite the small added expense, it is cost-effective to provide transgender-related medical insurance coverage because the presence of gender-affirming care reduces negative and costly outcomes including incidence of HIV, depression, suicidality, and drug abuse. In addition to avoiding these negative outcomes, proposed benefits include improved access to the workforce and a resulting decrease of reliance on government subsidies [31].

Controversies surrounding gender-affirming surgical procedures are as old as the procedures themselves. Despite good evidence supporting the efficacy of affirming care and recent increases in visibility and acceptance of transgender individuals, debates rage on about whether and how insurance should cover transition-related care [14, 15, 18–20]. Against the backdrop of rising healthcare costs worldwide and expanding access to care, it will be necessary to define and justify which procedures should and should not be covered by insurance and why. US third-party insurers as well as select countries such as Sweden and Holland have integrated FGCS in their treatment algorithm for transgender patients [32].

Determining which procedures should be considered medically necessary for transgender individuals seeking treatment requires an articulation of what treatment aims to do. The WPATH asserts that the purpose of the SOC is to "provide clinical guidance for health professionals to assist transsexual, transgender, and gender-nonconforming people with safe and effective pathways to achieving lasting personal comfort with their gendered selves." It identifies genital and chest surgeries as medically necessary for this purpose, while other gender-altering procedures including FGCS, liposuction and lipofilling, implants, and voice surgery are defined as "other surgeries." As such, the increasingly flexible diagnosis of gender dysphoria and the broadly stated goals of the SOC are employing interventions developed in response to a narrow and genital-centric diagnosis of transsexualism, one focused on sex as a primarily genital property. Although the SOC still identifies chest and genital reconstruction as the means of surgical transition, this is not a claim supported by a growing number of trans-surgical patients.

Defining the medical necessity and therapeutic legitimacy of FGCS is particularly tricky since it is not one set of procedures but rather a conglomerate of craniofacial procedures, several of which have traditionally been thought of as cosmetic. Of course, procedures themselves are neither cosmetic nor reconstructive; it is the patient outcome to which the procedure is applied that determines its intent and effect. Current evidence supports our position that FGCS should be considered a medical necessity for transgender women with recognizably masculine features. It may also be considered so for those transgender men who are not recognized as male following the masculinizing effects of testosterone supplementation. The question of how to frame the medical necessity of FGCS is complicated by the fact that FGCS names an *aim* of surgical intervention rather than a strictly defined and universally applied set of bone and soft tissue procedures. Clinicians and policy makers must work to build consensus first about the therapeutic benefits of FGCS and next how to communicate those benefits as a part of medically necessary treatment for some patients experiencing gender dysphoria. A proposal of procedures that should be included under the umbrella of medical has been reported in the literature [14] (Table 11.2).

Table 11.2 Proposed female facial gender confirmation procedures

Forehead reconstruction (including eyebrow repositioning)
Lower jaw and chin contouring
Rhinoplasty
Laryngeal chondroplasty
Hairline treatment or redefinition
Laser hair removal/electrolysis

Although there is considerable evidence from patient perspectives on the desirability and efficacy of FGCS, further research is needed to help demonstrate clinical efficacy and produce guidelines for FGCS best practice. These include the need for validated instruments to assess outcomes and patient satisfaction [21, 33] and the need to develop patient action protocols [19].

Those who oppose designating FGCS as medically necessary often do so not by contesting its therapeutic value or benefit to patients – a point which is frankly uncontested – but by asserting the problems that such a designation poses for health insurers. How can they justify covering a rhinoplasty for a trans woman with a marked dorsal hump, for example, when the same procedure would not be covered for a cisgender person with the same unaesthetic feature? Of course, health insurance providers make such distinctions all the time. The medical necessity of a procedure is determined by its relation to a qualifying diagnosis, not decided in advance by the technique employed. Patients with ptosis undergo reconstructive blepharoplasty (blepharoptosis) while patients with aging faces undergo cosmetic blepharoplasty, for example. Similar techniques are used to different therapeutic ends.

The artificial line between reconstructive and aesthetic surgery is constantly in negotiation. There were days when a simple cleft lip was considered a purely aesthetic defect; few would argue today that this is indeed a solely aesthetic concern. Over time, we have become aware that

normal facial structure has vital physiological as well as social function. The stigma associated with unusual or abnormal facial appearance can have wide-ranging effects, including negative self-esteem and social exclusion. The insight from FGCS patients and providers is that sexually distinct facial features can result in these same negative consequences for transgender individuals whose faces render them unrecognizable to themselves or others as the gender with which they identify.

The role of the medical and scientific community is to demonstrate that a procedure indeed has the effect it set out to have. Although more studies are welcome and needed, current evidence is conclusive on the therapeutic efficacy of FGCS [14]. Through educational efforts and advocacy work, this evidence has led to a recent increase in coverage through third-party insurers and select state Medicaid programs. This development may serve as a stepping-stone to confirm the need and benefit in the treatment of gender dysphoria by means of FGCS and assist in further expansion of care. The broadening of the diagnosis of transsexualism into gender identity disorder, gender dysphoria, and now gender incongruence has occurred because of our evolving understanding of gender and the associated treatment approaches that allow individuals an authentic, productive, and safe life. Medical and surgical responses evolve alongside, and must consider patients' experiences of their sexed and gendered faces with as much gravity as we've long given to their chests and genitals.

FGCS may for many be the most important affirming surgical procedure to allow patients to live life to its fullest and be productive members of society without fear of harassment, discrimination, and internal dysphoria.

Conclusion

Facial features are the most defining and recognizable gender marker and make individuals whose gender expression is incongruent with their physical appearance prone to numerous negative psychosocial sequelae. Research has confirmed the efficacy of FGCS, and it is therefore time that this set of medically necessary procedures be more clearly defined as such and therefore more widely available through healthcare advocacy and surgical training.

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12 Facial Gender Affirmation Surgery: Facial Feminization Surgery and Facial Masculinization Surgery

Jordan Deschamps-Braly

Background

The history of transgender surgery has an interesting place in time. Before describing the techniques used to feminize or masculinize the face, a brief tour of these procedures is warranted.

Issues relating to gender nonconformity span the history of human civilization. There are descriptions of individuals who fit the modern-day description of a transgender person, who were revered in various ancient societies. This includes ancient Egypt, the Indian subcontinent, Europe, sub-Saharan Africa, and even the North American Native American population. These descriptions also include modern-day religions such as Islam, Hinduism, and, to a lesser extent, Buddhism. Overall, it is unclear to what extent these descriptions depict cultural attitudes toward transgender individuals or are isolated events that were noteworthy and therefore preserved.

In more recent times, the lack of recordkeeping highlights the biases of human prejudice. In addition, the intentional destruction of literature by less enlightened parties is quite shocking. The birth of modern transgender healthcare originates in Germany, between the two great wars of the twentieth century. The activities of a German Jewish physician Magnus Hirschfeld, also called the "Einstein of Sex" by *Hearst* newspaper in 1931, served as the cornerstone of modern-day transgender care. Dr. Hirschfeld served as a source of empathy and care for a population that was scorned by society. Magnus Hirschfeld was born in 1868 in Kolberg, Poland to an Ashkenazi Jewish family. Dr. Hirschfeld migrated to Germany in 1880 studying philosophy and medicine, even visiting the United States during this time. He identified as homosexual and advocated that there was nothing intrinsically wrong about his sexual orientation. In 1897, Hirschfeld founded the Scientific Humanitarian Committee with an aim to overturn and reform laws which criminalized homosexuality in Germany. In order to achieve this goal, two tactics were employed: (1) to study homosexuality as an anthropological and medical science and, more controversially, (2) to "out" prominent closeted homosexuals. The purpose of the "outing" tactic was to demonstrate that "normal" and even prominent people identified as homosexual. This was intended to raise awareness, change the perception of homosexuality, and influence lawmaking. Early petitions were signed by notable people, including the physicist Albert Einstein and the author Herman Hesse. In addition to Hirschfeld's work regarding homosexuality, in 1904, he joined the Bund für Mutterschutz (League for the Protection of Mothers), a feminist organization that campaigned for decriminalization of abortion and other pro-female causes.

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In 1919, during the Weimar Republic, Hirschfeld formed the Institut für Sexualwissenschaft. The laws against homosexuality were still in place; however, they were not enforced by the government. The institute became a mecca for the study of sexology and also housed a public museum. The "Institute" hosted individuals from around the world who hoped to gain greater understanding regarding the study of sexology. In addition, medical procedures were performed in the "Institute," and many of the staff were marginalized people who identified as homosexual or transgender. It is Hirschfeld who is credited with coining the term "transsexual."

The first patients to undergo surgical treatment for gender dysphoria were likely intersex individuals. In 1907, a patient by the name of Karl Baer [1] underwent what seems to be some type of metoidioplasty. Following the discovery of an affair, Karl attempted suicide by stepping in front of a streetcar in Berlin. Karl's identification paperwork stated his name as Martha, which did not correlate with his appearance. Karl ultimately married the woman with whom he was having an affair and moved to Tel-Aviv. The records of his medical care were destroyed by the Nazis; however, he published his memoirs under a pen name of N.O. Body. The epilogue was written by Magnus Hirschfeld. As such, much about his history is well known [2].

Lile Elbe, "The Danish Girl," is referenced in popular culture as the first transgender person to undergo surgery. Ms. Elbe's surgery was performed in Dresden in 1933 by Dr. Kurt Warnekos. However, one decade earlier, in 1922, the first known "male-to-female" transgender person to undergo medical procedures related to gender dysphoria was Rudolph Richter. Rudolph was a "house-maid" in the Hirschfeld's "Institute." While there, she underwent an orchiectomy. Subsequently, she underwent a penectomy by Dr. Levy-Lenz and a "vaginal reconstruction" by Dr. Gorhbrandt [3]. Dr. Levy-Lenz initially practiced as a gynecologist at the Institute. Following the destruction of the Institute by the Nazis, Dr. Levy-Lenz relocated to Egypt and developed a reputation as a highly regarded "cosmetic" surgeon.

The first facial procedures occurred long after genital surgeries and were pioneered and described by Douglas Ousterhout MD, DDS, FACS, in the late 1980s (Fig. 12.1). Douglas Ousterhout was the first American fellow of the world-renowned French craniofacial surgery pioneer Dr. Paul Tessier. Following his training as a maxillofacial and plastic surgeon, Dr. Ousterhout spent one year in Paris with Dr. Tessier. Ousterhout recalled to me that Dr. Tessier had said that someday "this amazing craniofacial surgery will become very useful for cosmetic surgery." [4] Ousterhout began his practice in San Francisco in 1974. He maintained a private practice and also joined the cleft surgery clinic at The University of California San Francisco, which had been founded by Dr. John Owsley. In 1982, Lucy, a transgender woman, came to the office of Dr. Ousterhout. She said that her forehead was a source of dissatisfaction for her; she felt that she was gendered incorrectly because of it.

At the time, craniofacial surgery focused on congenital anomalies, and little thought was given to the differences that gender and sex gave to the facial skeleton. Ousterhout researched this question at the "Atkinson Skull Library" at the University of the Pacific Dental School. By studying both skulls and anthropology texts, Ousterhout determined the craniofacial skeletal differences between male and female skulls. He then devised a number of operations to feminize the forehead and the mandible, and he published his techniques in 1987 [5]. Subsequent academic work by Spiegel et al. demonstrated a positive correlation between transgender patients receiving facial feminizing procedures and an improvement in their psychosocial health [6]. In 2011, Ousterhout described facial masculinizing procedures. These procedures were initially based on cisgender men seeking to masculinize their face by modifying the craniofacial skeleton. In 2017, Deschamps-Braly et al. published a report of the first transgender male to undergo facial masculinization, including a new technique for augmenting the thyroid cartilage to enlarge the "Adam's apple" [7]. These feminizing and masculinizing procedures have been adopted worldwide and are becoming more prevalent.

Fig. 12.1 (**a**, **b**) Facial feminization procedures for transgender patients, such as the surgeries performed on this patient, were pioneered by Douglas Ousterhout, MD, DDS, FACS

Feminization of the Hairline

The hairline is important in the evaluation of a patient for either facial feminization or facial masculinization surgery. Female hairlines differ from male hairlines. In cisgender females, the center point of the hairline is lower than in cisgender males. In cisgender females, the center point is about 5.5–5.8 cm above the center point of the eyebrows, whereas in cisgender males, the center point typically exists 7–10 cm above the center point of the eyebrows [8, 9]. In cisgender men, 80% of the time the hairline has a small "V" in the middle, known as the "widow's peak." The term "widow's peak" is derived from the superstitious belief that having one was an early predictor of widowhood. The term is commonly misused, particularly since male pattern hair loss has characteristic recession on either side of the middle tuft (the temporal peaks), mimicking an actual widow's peak. Considering that the size of the face is often measured from the level of the hairline, lowering a patient's hairline can give the impression of a smaller face.

However, when considering facial height, the surgeon must also consider facial proportions. The often referenced "rule of thirds" is not an accurate measurement and attempts to package a formula for surgical success that does not apply to the vast majority of humans. Most notably, the surgeon should consider the height of the patient. For instance, a tall patient with a large face will tolerate a longer hairline, whereas a short patient will require a lower hairline position. In addition, the height of the upper face should balance the patient's midface height. If the patient has a long midface, and the patient does not desire correction (i.e., midface impaction), then a higher hairline may be acceptable.

Additional important landmarks regarding the hairline are the temporal points and the temporal mounds. The temporal points refer to the arrow-shaped points of hair, and the temporal mounds refer to the wispy hair composed of single follicle hair units through which the scalp is often visible. According to one detailed study of female hairlines, the temporal points were present in 98% of the subjects [10]. This area can only be corrected using hair transplants, as no surgical procedure can adequately relocate tissue into this area. Conversely, temporal recession may be treated using a combination of scalp advancement and temporal lifting. These maneuvers reduce the area to be treated by hair transplants.

In order to lower the hairline, the incision is placed at the junction of hair-bearing and non-hair-bearing skin. A tricophytic incision is used so as to allow regrowth of hair. The incision continues into the visible temporal hollow before turning inferiorly toward the ear (as with a traditional coronal incision).

After making the "hairline" coronal incision, the scalp is elevated in a subgaleal plane to the level of the occiput. This allows for forward mobilization of the scalp. If additional advancement is required, galeotomies may be performed. However, care must be taken to avoid damage to the vascular pedicles of the scalp. Following advancement, the scalp is fixed to the bone. The author's preferred fixation technique is unicortical tunnels and resorbable suture. Following posterior flap fixation, excess skin is removed from the anterior flap. If there are significant forehead rhytids or glabellar furrows, frontalis myotomies and/or corrugator or procerus resection may be performed.

Hair transplants are a useful adjunct and may compliment a scalp advancement. Traditionally, the author prefers to wait six months prior to performing hair transplantation. More recently, we used the follicular unit method to transplant hair taken from the temples during closure of the hairline coronal incision. However, the survival rate of transplanted hair follicles performed in this manner is not as high as when transplants are delayed. The author estimates that only 60% of the grafts survive when performed concomitant with surgical scalp advancement. Capitan et al. have written about immediate hair transplantation as a primary technique for lowering and reshaping hairlines [11]. They describe harvesting a strip of hair during closure of a traditional coronal incision. The disadvantage of this technique is that a coronal incision raises the hairline, thereby requiring even more hair than would be needed if a scalp advancement was performed. An additional disadvantage is that grafted hair,

although convincing in the temples, is less convincing in the central hairline.

Alternatively, when forehead lengthening is required, a coronal incision is placed behind the hairline. Forehead lengthening is performed to address a low hairline or when facial masculinization is requested. Galeotomies through the frontalis muscle may be performed (less than 5% of transfeminine patients). Incidentally, galeotomies should stop medial to the terminal branches of the facial nerve. Approximately 1–1.5 cm of forehead lengthening may be achieved (Fig. 12.2).

The Forehead

Cis-female and cis-male foreheads are shaped differently. Cis-male foreheads are more protruded in front of the eyes, giving the sense of deeper set eyes. Additionally, the cis-male forehead tends to have prominent glabellar bossing above the orbits and also has an alternating convexity and concavity (as opposed to the cis-female foreheads which tends to be convex in all directions). The lateral orbital rims are also more prominent in the cis-male skull and may also require modification.

Forehead modification would be simple if it weren't for the existence of the frontal sinus. The sinus results in an overall lighter weight to the skull and speculation suggests this may provide an evolutionary advantage. In Ousterhout's retrospective analysis of his patients, 5% of patients either did not have a frontal sinus or had a sufficiently thick frontal sinus that contouring could be achieved without an osteotomy [12]. The author's experience indicates that only 3% of patients lack a sinus, and another 3% of patients have a hypoplastic unilateral sinus. In 89% of the author's cases, forehead modification requires osteotomy and reconstruction of the anterior wall of the frontal sinus.

Four forehead configurations were described by Ousterhout in his landmark 1987 paper describing forehead feminization [5].

Forehead Type I

The type I forehead either lacks a frontal sinus or has a frontal sinus which is sufficiently thick such that contouring may be performed without an osteotomy. The author estimates this configuration occurs in 3–6% of his patient population.

Forehead Type II

The type II forehead implies that the glabellar ridge is situated in an appropriate anterior-posterior position and that surgical modification should focus above this level. This typically involves augmentation of the recess above the frontal bossing; adjustments to the orbital aperture and the lateral orbital rims may still be required. Options for forehead augmentation include hydroxyapatite, calcium phosphate putties, and methyl methacrylate (MM). Methyl methacrylate has a long history of use in craniofacial applications and is relatively inexpensive [13]. In terms of facial feminization, methyl methacrylate was best studied by Ousterhout who described shaping approximately 400 methyl methacrylate implants [14, 15]. Among that group, there were only two infections. One patient required removal due to infection from a frontal sinus fracture after secondary trauma, and another patient seeded the implant due to a sternal wound infection after open-heart bypass. Both instances of infection occurred years after placement of the implant. It is important to recognize that if exposure of the sinus occurs, augmentation of the forehead should be avoided as this exposes the implant to airway bacteria. Methyl methacrylate does have some drawbacks. The primary drawbacks are heat generation and potential toxicity during the curing phase. In order to avoid bone necrosis, no more than 5 mm of methyl methacrylate should be placed before allowing it to cure [16]. Additional layers of material may be added secondarily (Fig. 12.3).

Fig. 12.2 (**a**, **b**) Compared to male foreheads, female foreheads are less protruded in front of the eyes, do not have prominent glabellar bossing above the orbits, and are more likely to be convex. This patient has undergone forehead contouring, among other procedures

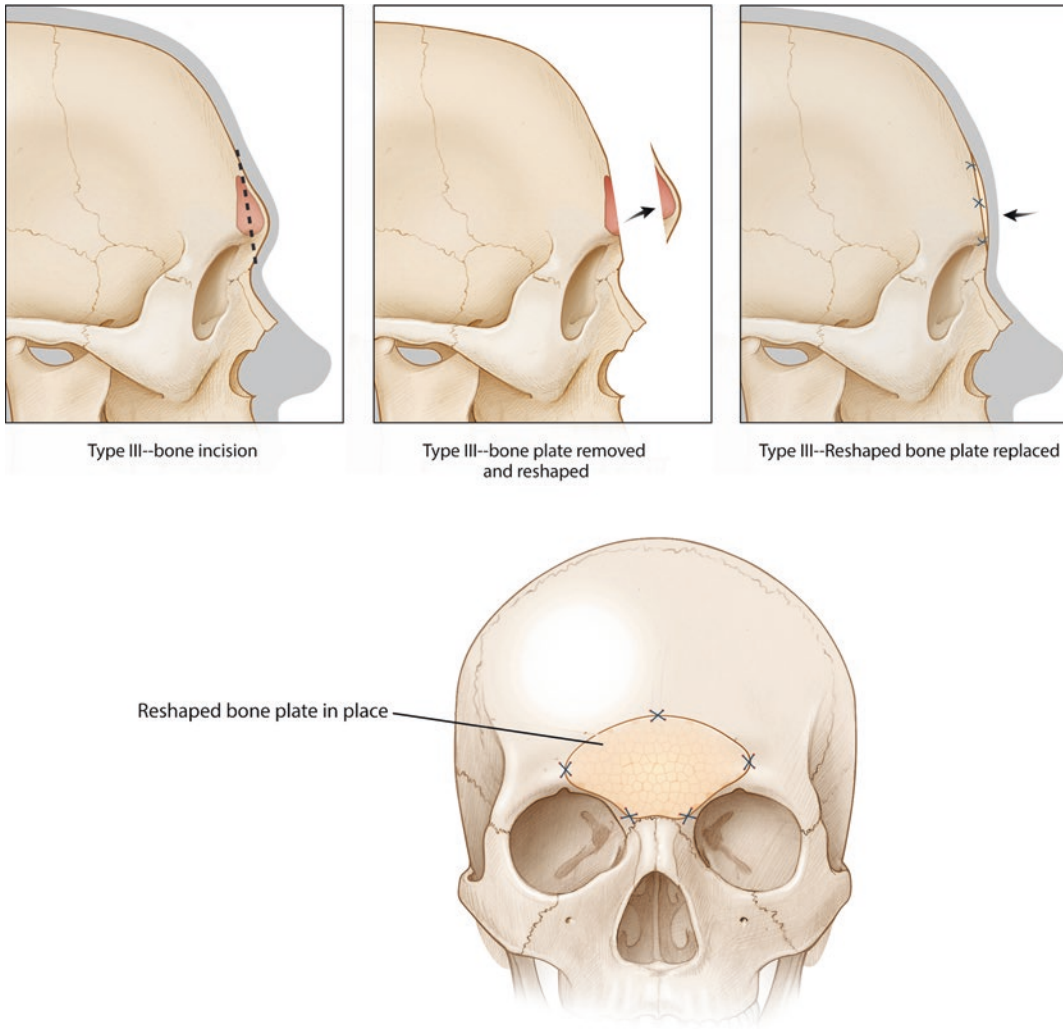
Type III--bone incision
Type III--bone plate removed and reshaped
Type III--Reshaped bone plate replaced
Reshaped bone plate in place

Fig. 12.3 The type III forehead demands the most technical skill when feminizing a forehead. Pictured above is a typical bone incision made in a type III forehead, the removal and reshaping of the bone plate, and replacement of the reshaped bone plate. (Illustrations ©2018 Christine Gralapp)

Forehead Type III

The forehead type III is the most common situation we encounter. Incidentally, it is also the most technically demanding and difficult procedure to master as it requires mastery of both craniofacial surgery and plastic surgery. While pediatric craniofacial surgery often requires large overcorrections and intentional lack of precision because of the variables that growth, relapse, and resorption entail, the opposite is true when performing a type III forehead procedure. The fit and finish of the result must be similar in quality and character to that of fine artisanal woodworking. The result is permanent, irregularities of 1 mm may be felt through the skin, and bone grafts must be secured well to avoid resorption. Gentle technique and pericranial preservation must be meticulous, as the entire bone flap is vascularized through close adherence of the pericranium. Also, prevention of temporalis muscle retraction is important, as this creates an unsightly bulge in the temporal fossa which is difficult, if not impossible, to correct.

The type III procedure (required in approximately 93% of patients) involves treatment of the

central forehead as well as reduction of the lateral orbital rims and shaping of the orbital aperture. Treatment of the central forehead requires osteotomy and reshaping as burring alone is rarely sufficient to feminize this type of forehead. In fact, burring alone is often barely visible through the thick skin of the forehead. Furthermore, if only the lateral orbital rims are addressed, patients will have a common characteristic central prominence, for which they often seek revision.

The central forehead is treated with tangential osteotomy. Preoperative x-rays and CT scans help to ascertain the extent of the sinus; however, no particular technique is used to mark or outline the sinus prior to surgery. After performing the osteotomy, septa that may restrict drainage are removed, and if the naso-frontal duct is too small or an ethmoid air cell interferes with the drainage pathway, those passages may be opened. A high-speed rotating burr is used to "fine-tune" the shape of the forehead. Care is taken to reduce the risk of injury to the supraorbital nerve. However, in approximately 1–2% of patients, the supraorbital nerves cannot be preserved due to an aberrant exit from the forehead, sometimes as high as 2 cm above the level of the orbit. Once the desired shape is obtained, the bone graft is replaced and secured using stainless steel wire. The thinnest available plates and screws are 350 microns in thickness, while twisted 30 gauge stainless wire has only a 200 micron diameter. This difference may reduce the likelihood of palpability, especially with skin thinning as a result of aging and hormone therapy. Pericranial flap placement, scalp advancement, and skin closure complete the procedure.

Forehead Type IV

Type IV forehead feminization is the least common situation encountered. This category describes a forehead that is too small with underprojection of the brow ridge. In these cases, pan-forehead augmentation is required. While quite rare, treatment is similar to that described for type II feminization with the addition of material to the area above the eyes and the forehead.

Rhinoplasty

Discussion of rhinoplasty techniques is sufficiently complex to encompass an entire book, and this is not intended to be an exhaustive analysis of rhinoplasty techniques. The intent is to frame the issues of feminizing rhinoplasty. The majority of rhinoplasties performed in transgender women are reduction in nature, while rhinoplasties in transgender men are most frequently augmenting. There are exceptions to these general paradigms, most typically in African American or certain Asian noses. The most important modern-day advance was made in Hungary in the 1920s when Rethi described the use of the columellar incision. This allowed visualization, which, prior to that, was not possible [17]. In the context of feminization surgery, when the forehead is recessed, the nose will appear larger. In addition, a step is created at the junction of the forehead and nose just above the radix. This step may be visible if the nose is left unattended.

The creation of a smooth dorsal line from the new forehead to the caudal tip of the septum is critical, and the proper naso-frontal angle, naso-labial angle, and angle of the nose relative to the facial plane should also be considered. Achieving these goals often entails large dorsal reductions, sometimes as large as 6–7 mm. This creates large open roof deformities and necessitates medialization of the nasal bones. In nasal feminization, spreader grafts made from septal cartilage are often too wide and must be modified. The nasal tip is almost always too large, and modification of the lower lateral cartilages is required. Lastly, the need to perform alar wedge resections is more apparent in feminizing rhinoplasties. The author consents all patients for alar wedge excisions but only makes the decision to perform this maneuver at the conclusion of the case. It is often difficult to predict the necessity of alar wedge resections given the dramatic changes that are otherwise performed.

One concern regarding reduction rhinoplasties is the potential for secondary deformities. With the exception of one instance, we do not find this to be the case. Reduction of the radix, which is

Fig. 12.4 (**a**, **b**) The procedures performed in this patient, including forehead contouring, scalp advancement, brow lift, rhinoplasty, and upper lip lift, have dramatically reshaped the face

often necessary in order to blend the forehead and the nose, may lead to excess skin of the medial canthal region. Should this fail to resolve, secondary treatment is performed using a medial upper lid blepharoplasty with a W type extension (Fig. 12.4).

Upper Lip

The upper lip length varies in men and women and with age. The typical male vertical upper lip length ranges between 20 and 22 mm in older patients and 18 and 20 mm in younger patients. A typical youthful female vertical upper lip measures between 14 and 16 mm with approximately 4–5 mm of upper tooth show. Upper lip height reduction is often performed in conjunction with lip augmentation in order to produce more tooth show, increase the visibility of the upper lip vermillion, and add volume to reduce wrinkling. It is also possible to perform concomitant resurfacing procedures as long as the area of the incision is avoided. If the corners of the mouth are downturned, direct excision along the vermillion border may be performed. However, this procedure may improve visualization of the vermillion rather than correct the downturn (Figs. 12.5 and 12.6).

The Jaw

The cis-male jaw is larger and broader than the cis-female jaw. The gonial angles are sharper, the mandibular plane is flatter, and the oblique line on the midbody portion of the mandible is heavier and thicker. While different structures, the jaw and chin should be considered together so as to allow simultaneous contouring. The

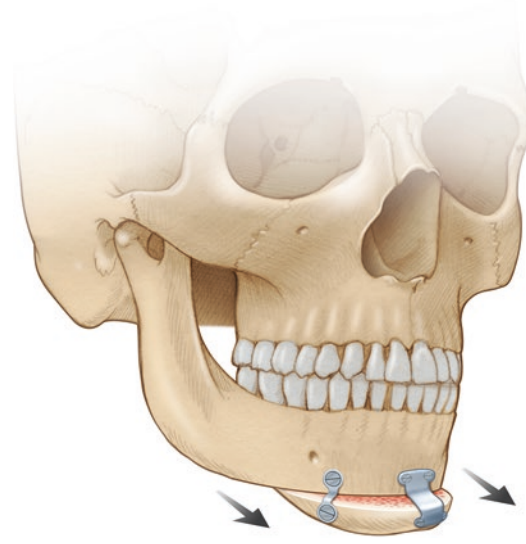

Fig. 12.5 Genioplasty Advance Illustration) A T-osteotomy of the chin is used to achieve vertical height and width reduction in facial feminization. This method can also allow for advancement when necessary. (Illustrations ©2018 Christine Gralapp)

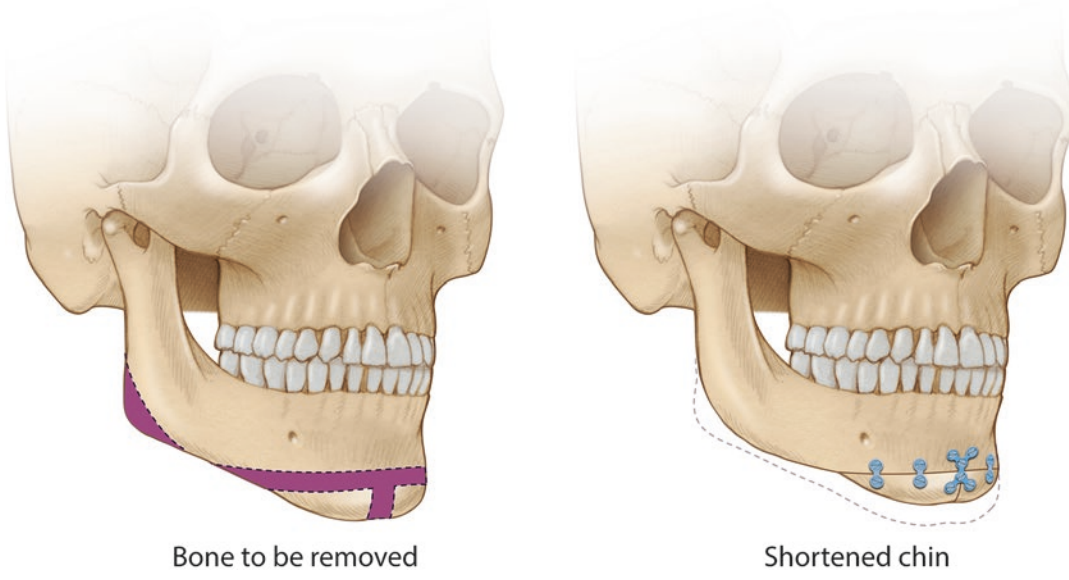

Fig. 12.6 The chin is much taller in males than females. Vertical reduction of the mandible (as in the photo here) is often needed when providing facial feminization surgeries for transgender patients. (Illustrations ©2018 Christine Gralapp)

usual maneuvers include burring or removal of portions of the outer table of the mandible and, in some circumstances, removal of spongy bone so as to narrow the jaw. Masseter muscle reduction may be performed via an intraoral approach; however, some reduction of the masseter may be achieved with removal of the gonial angle. Oftentimes, wide degloving of the mandible is required. This mandates protection of the soft tissues, including both the mental and marginal mandibular nerves.

The cis-male chin is vertically taller, even when adjusting for height. Therefore, vertical reduction is almost always warranted. Approximately 85% of patients are suitable candidates for chin surgery as part of their facial feminization procedure. This typically involves osseous genioplasty, as a chin implant does not result in feminization. Chin implants make the chin larger, usually in the anterior vector. While this may correct retrogenia, it does not improve the chin shape or vertical height. SA Wolfe described methods to alter the vertical height of the chin in 1987 [18]. His technique has been modified into a T-osteotomy of the chin. This osteotomy allows for both vertical height removal and width reduction, and also allows for either advancement or setback when necessary. Knowledge of dento-facial planning techniques helps to determine chin position (in both the vertical and anterior-posterior dimensions). Also, appreciation of changes in the facial plane as a result of concomitant forehead surgery should be considered when planning chin surgery.

Titanium hardware fixation allows for stable fixation. Lateral fixation may be required if segmentation of the chin was performed. Knowledge of mental nerve anatomy is required to prevent injury; the position of the nerve is lower than the mental foramen, as the nerve runs cranially so as to exit the foramen [19]. Numerous studies demonstrate the safety of osseous genioplasty. When appropriate precautions are taken, lip sensation should remain largely intact. However, transient lip numbness is common, and often resolves over the course of two years. These sensory alterations may also affect the lower incisors. On occasion, a small, midline vertical strip of hypesthesia may persist (Figs. 12.7 and 12.8).

The Thyroid Cartilage

The thyroid cartilage sits atop the cricoid and trachea. From a functional perspective, it provides a framework for swallowing, closure of the airway during swallowing, and helps to maintain vocal cord tension. Cis-male thyroid cartilage is larger and more projected than cis-female thyroid cartilage and results in the characteristic masculine Adam's apple. The Adam's apple is often a concern for individuals who are transitioning in a binary fashion. However, the author has also treated cisgender individuals (both male and female) who are bothered by the appearance of their Adam's apple. Chondrolaryngoplasty was first described by Wolfort et al. in 1975 [20], and in 1990, he published a series with 30 patients [21].

The thyroid cartilage may be approached directly or, in the author's preferred technique, indirectly. The direct approach entails an incision directly over the top of the thyroid cartilage. Alternatively, the indirect approach utilizes a submental incision similar to that used in a facelift. This incision requires skin undermining with separation of the strap muscles from above. The benefits of this approach include a concealed scar and a scar that does not adhere to the underlying cartilage. Scar adherence is often seen in the direct approach. This results in unsightly movement when the patient speaks.

In young patients, the cartilage is soft and can be reduced with a blade. During cartilage removal, avoidance of the site of vocal cord insertion is important. This area is usually significantly below the level of the most prominent portion of the cartilage. Visualization of the vocal cord insertion is facilitated with the use of a fiber-optic scope and laryngeal mask airway. The location of vocal cord insertion can be marked so as to allow precise cartilage reduction. Historically, there were a number of patients who complained of long-term hoarseness following this procedure (Fig. 12.9). Milton Edgerton drew attention to this in his discussion to Wolfort's original article [22].

Masculinization of the thyroid cartilage may also be performed. This was described by Deschamps-Braly et al. in 2017. [7] This procedure is performed through a submental limited access approach. Rib cartilage is harvested and

Fig. 12.7 (**a**, **b**) In this patient, a genioplasty was performed to taper the jaw

Fig. 12.8 (**a**, **b**) Genioplasty has tapered the jaw and feminized the chin in this patient. To create a more feminine appearance, other procedures were also used, including forehead contouring, scalp advancement, brow lift, and rhinoplasty

Fig. 12.9 (**a**, **b**) The thyroid cartilage was reduced in this patient to make the Adam's apple less prominent. The patient also underwent forehead contouring, fat grafting, rhinoplasty, upper lip lift, and tapering of the jaw

shaped in a fashion analogous to that of ear reconstruction. The cartilage construct is fixed to the overlying native thyroid cartilage, usually in a slightly lower position. The strap muscles are approximated over the cartilage in order to present a more masculine appearance.

Other Procedures

There are various additional procedures that may be considered in the context of facial surgery. Some of these procedures may be performed concurrently, while others are best performed in stages. These procedures are not necessarily specific to feminization and often have an element of beautification or rejuvenation. For instance, while many patients may benefit from upper lid blepharoplasty or facelift, in the author's opinion, these are best performed secondarily. It is difficult to determine the exact and ultimate brow position following forehead surgery, and under−/over-resection of upper lid skin is possible. Similarly, estimating skin resection at the time of underlying skeletal work is difficult. As such, a facelift is best performed following resolution of skin swelling. Other procedures, such as cheek implants, are not necessarily feminizing. While there are ethnic differences in cheek shape, there are not necessarily reproducible differences in cheek shape between cis-men and cis-women. Cheek implants (or lipofilling) may be used to enhance aesthetic results, but are not necessarily gender related (Fig. 12.9).

Conclusion

Under the combined term of facial gender affirmation surgery, facial feminization surgery and facial masculinization surgery provide power tools to improve the lives of transgender and gender-nonconforming individuals. These procedures are technically demanding. However, if one is willing to undertake the prerequisite training, it is a fulfilling surgery that can be rewarding to the provider. The author recommends that surgeons begin with procedures they can safely accomplish and that are within their scope of practice.

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Chest Masculinization Surgery

16

Cori A. Agarwal and Daniel P. Donato

Introduction

Chest reconstruction in transmen, sometimes referred to as "top surgery," or chest masculinization, is often an important part of the transition process. It is often the initial procedure performed and sometimes the only procedure performed [1, 2]. In a survey of transgender men, the majority reported either having had chest surgery (36%) or desiring it in the future (61%) [3]. Chest reconstruction can also be important for nonbinary individuals who are distressed by the presence of their breasts. While cross-sex hormone treatment goes a long way in allowing transgender men to "pass" in public as their preferred gender, distress over the presence of their breasts contributes to numerous social, physical, and psychological problems. Many bind their breasts daily with tight wraps and restrictive garments in order to conceal them, a process that is uncomfortable, is cumbersome, and can lead to rashes, acne, restriction in activity, and even difficulty breathing. Studies suggest that chest masculinization improves self-esteem and body image and as a result improves quality of life [4, 5]. The goals of chest masculinization surgery are to provide smooth masculine chest contours, minimize and camouflage scars along anatomic lines, and create an aesthetic male nipple-areolar complex (NAC).

Criteria for Surgery

Readiness for surgery is typically determined in a multidisciplinary fashion, including evaluation from a mental health professional. The World Professional Association for Transgender Health (WPATH) Standards of Care (SOC) version 7 proposes the following criteria: (1) having persistent well-documented gender dysphoria (ideally with one letter of support from a qualified mental health professional), (2) the capacity to make a fully informed decision and to consent for treatment, (3) the age of majority, and (4) having well-controlled medical or mental health concerns (Table 16.1) [6].

In contrast to genital surgery, patients do not need to live as male for 1 year and do not need to be on hormone treatment prior to the chest surgery. In fact, for some transmen, it is desirable to

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Table 16.1 WPATH SOC, V7, criteria for chest surgery for adults

1. Persistent, well-documented gender dysphoria (one mental health referral letter)
2. Capacity to make a fully informed decision and consent for treatment
3. Age of majority in a given country
4. If significant medical or mental health concerns are present, they must be reasonably well controlled

have their breasts removed as the first medical step in the transition process as it can be socially awkward to show signs of masculinization with breasts present. The use of testosterone preoperatively can, however, improve the aesthetic result of the chest surgery by causing hypertrophy of the pectoralis muscles and atrophy of the breast tissue.

Criteria for chest reconstruction in adolescents are similar to adults, although the WPATH SOC guidelines indicate that the patient lives for an "ample" time as male and that they undergo testosterone treatment for 1 year. The described intent is "to give adolescents sufficient opportunity to experience and socially adjust in a more masculine role, before undergoing irreversible surgery." There is a clause, however, acknowledging that an adolescent's specific clinical situation and maturity might argue for a different sequence and timeline, and a full year of testosterone is not an absolute requirement. Due to the nuances and sensitivity of correct diagnosis and decision making in the adolescent population, it has been our institution's practice to obtain letters of support not only from a mental health professional but also from a medical provider to thoroughly document the nature and persistence of the gender dysphoria. Additionally, as transition is frequently controversial for family members, it is important to obtain surgical consent from all parties with legal custody. We have found that with a multidisciplinary team, a strong family support system, and a mature patient, chest masculinization surgery in adolescents can be done safely and with excellent outcomes.

Preoperative Considerations

The initial consultation includes a complete history documenting the nature and extent of the gender dysphoria, a complete medical history, and a discussion about the goals and expectations of surgery. Planning for postoperative social support is also an important part of the visit.

As with any surgery, a healthy lifestyle reduces risks of complications and optimizes results. In smokers, patients are advised to refrain from smoking for 4 weeks prior to surgery. Poorly controlled diabetics are referred for optimization of their glucose control. Obese patients are encouraged to lose weight to lower their BMI as close to 30 as possible, although a heavier BMI does not preclude surgery but leads to poorer aesthetic results and potentially higher complications. For those patients on testosterone therapy, the aromatization of testosterone to estradiol theoretically increases the risk of perioperative venous thromboembolism (VTE). The extent of this risk, particularly in chest surgery, is not well established, and the need to discontinue testosterone prior to chest surgery is controversial. In our practice, we do not hold testosterone but utilize sequential compression devices and early ambulation for VTE prophylaxis [4, 7, 8].

A thorough personal and family history of breast cancer is taken in all patients. Preoperative breast imaging is obtained for any patient who meets criteria based on age, family history, or physical exam. The risk of occult breast cancer in the mastectomy specimen warrants discussion at the time of consultation. For those patients over the age of 30 and/or with other risk factors for breast cancer, the mastectomy specimens are sent for pathologic evaluation. For younger patients, the cost-benefit of sending the tissue to pathology is discussed, and a decision is made on a case-by-case basis. There are case reports of transgender men developing breast cancer after mastectomy [9–11], and it is important to discuss this with the patient before surgery so they understand that

surveillance of their chest after surgery, at least by physical exam, should be continued throughout their life.

Selection of Surgical Technique

A variety of mastectomy techniques for transmen have been described [1, 2, 7, 8, 12]. Choice of technique is based on multiple factors including breast size, degree of skin laxity, degree of ptosis, skin quality, and the size and position of the nipple-areolar complex (NAC). In selecting the technique, one must balance the desire to limit the extent of the scar with obtaining an optimal chest contour. The preferences of the patient regarding scars, willingness to undergo secondary and revision surgeries, and maintenance of NAC sensitivity are also factored into the technique selected.

Techniques can be broken down into three basic categories: (1) the periareolar technique, (2) a concentric circular technique with or without extended skin excision, and (3) the "double incision" technique, usually with free nipple grafts. Adjunct procedures frequently performed include nipple reduction and liposuction (Table 16.2).

While the periareolar mastectomy technique results in a small, well-hidden scar and typically maintains NAC sensation, its success relies on sufficiently small and non-ptotic breasts, small areolas, and good skin quality that will contract to the chest wall. Only a minority of patients, typically with small non-ptotic A cup breasts, are candidates for this technique (Fig. 16.1).

Table 16.2 Chest reconstruction techniques

1. Periareolar ("keyhole")
2. Concentric circular ("donut") (a) Simple (b) With extended skin excision (inverted-t, lateral darts, vertical, lower pole wedge)
3. Double incision (a) Free nipple grafts (b) Dermoglandular inferior NAC pedicle
4. Adjunct procedures (a) Liposuction (b) Nipple reduction

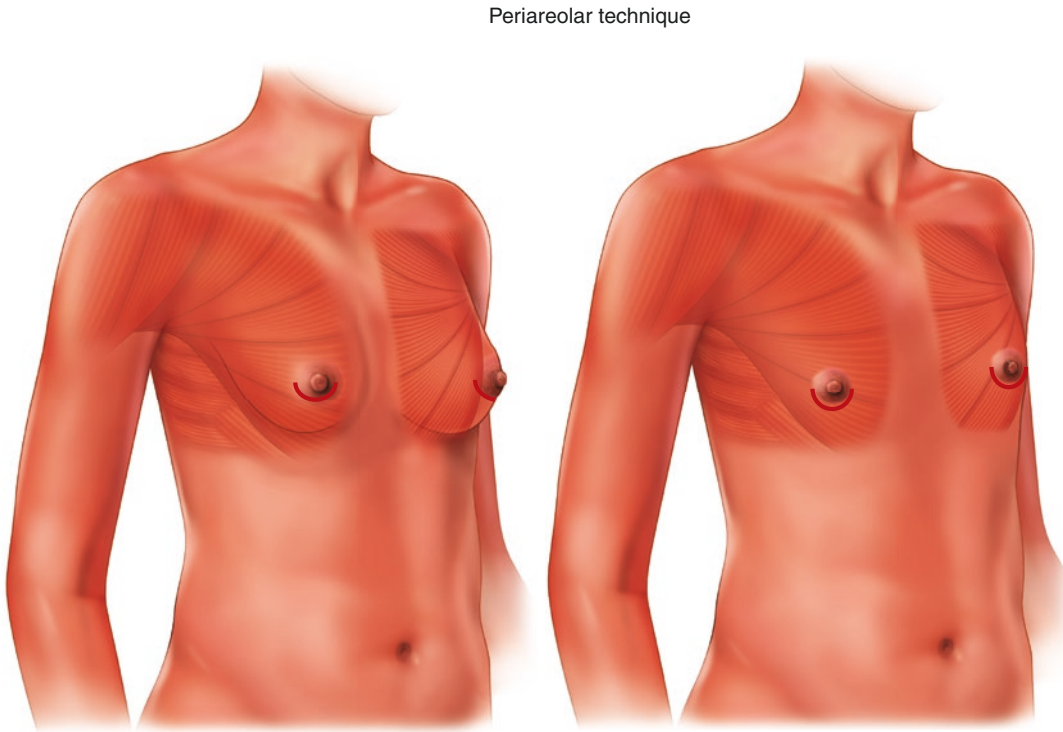

Fig. 16.1 Illustration of the periareolar technique with preoperative markings (left) and postoperative scar position (right)

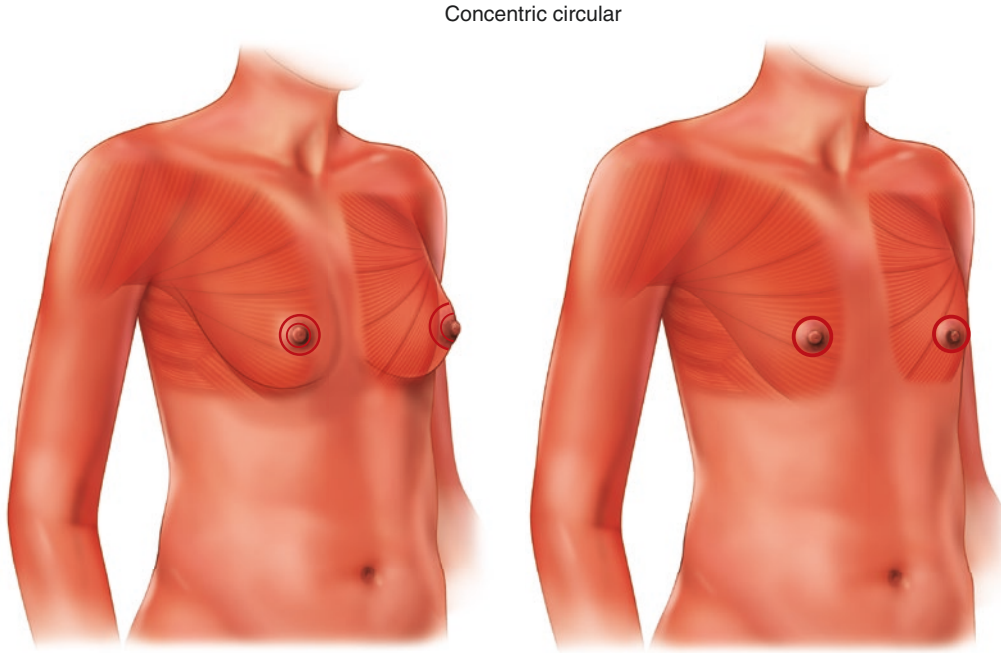

Fig. 16.2 Illustration of the concentric circular technique with preoperative markings and postoperative scar position

In slightly larger breasts, with a small amount of ptosis, a concentric circular technique allows for excision of a small amount of skin and areolar reduction along with the mastectomy. It can be performed as a Benelli, or "donut" mastopexy, method (Fig. 16.2) or can be combined with additional skin excision along either a lateral extension, medial and lateral extension (fish-mouth), inverted-t, vertical patterns, or wedge excision along the lower pole. These have in common a NAC that is maintained on a dermal pedicle combined with variable mastopexy techniques for additional skin excision. NAC sensitivity is often maintained, but the revision rate is higher as flat contours are harder to ensure [4]. For patients with larger breasts, moderate to severe ptosis, low positioned NACs, and poor skin quality, the best choice is "double incision" mastectomy technique with free nipple grafting (Fig. 16.3). We favor this technique as it allows for the most reliable creation of flap contours and optimal control over size and position of the NAC on the chest wall. The primary disadvantage is the length of the scars and the loss of NAC sensation.

Surgical Preparation

For each of the operative techniques, sequential compression devices are placed, and IV antibiotics are administered prior to the induction of anesthesia. Once asleep, the patient is positioned supine with the arms abducted to 90° on padded arm boards. Care is taken to ensure that the patient is centered and symmetrically positioned on the Table. A Foley catheter is rarely needed. The arms are wrapped so they will remain on the arm boards when the patient is positioned to an upright sitting position later in the procedure. A lower body forced-air warming air blanket is placed. The patient is draped to include the

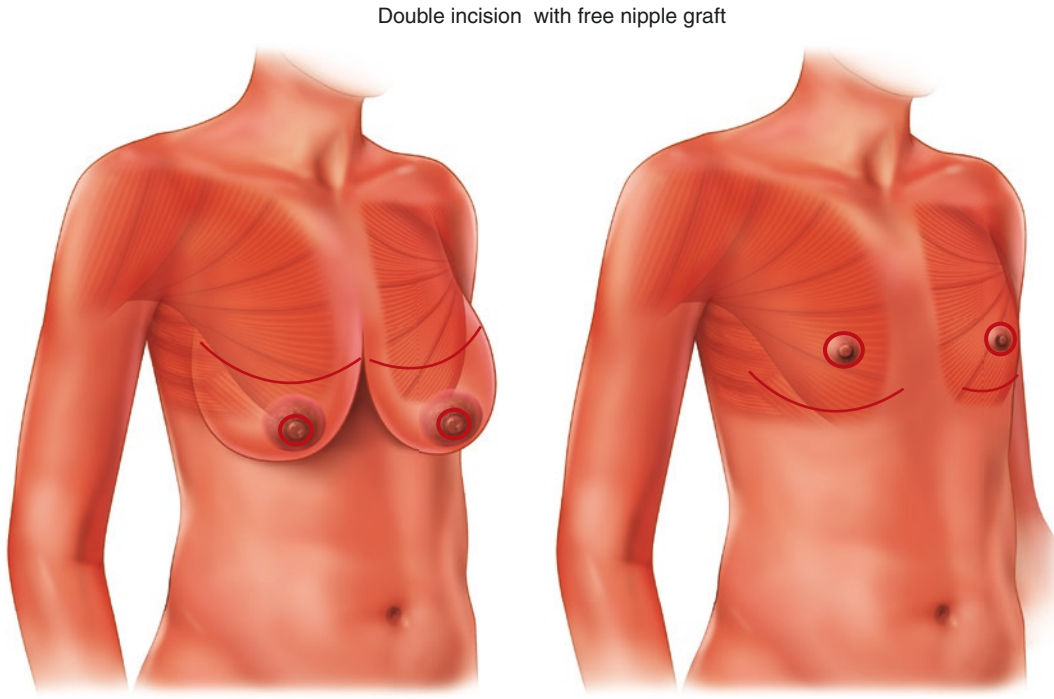

Fig. 16.3 Illustration of the double incision technique with preoperative markings and postoperative scar position

Fig. 16.4 Positioning for surgery. Arms are wrapped for upright positioning at times during the surgery

clavicles superiorly, to the umbilicus inferiorly, and as far lateral as necessary based on the markings (Fig. 16.4). Prior to incision, a field block around the borders of the mastectomy site is performed using 0.25% bupivacaine with epinephrine through 25-gauge spinal needles.

Periareolar Technique

Patients who have small, non-ptotic breasts with good skin quality and small areolar diameters are candidates for the periareolar technique. Preoperative markings are done with the patient in a standing position and arms at their side. The sternal midline is marked as well as the footprint of the entire breast, which can be palpated along the chest wall. Care is taken to mark the IMF and the lateral breast extent. The site of the incision is marked along the inferior aspect of the areola (Fig. 16.5).

For the periareolar approach, headlamps are employed and lighted retractors are used to obtain adequate visualization. Ideally, non-conductive retractors are utilized to avoid thermal injury to the incision edges. The inferior periareolar marking is incised and the parenchyma incised to a depth of about 1 cm. The NAC and the preserved underlying parenchyma

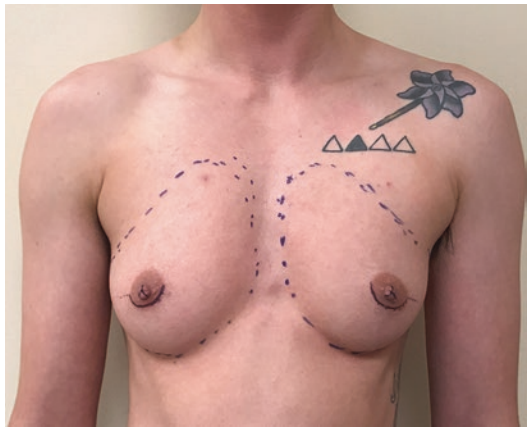

Fig. 16.5 Preoperative markings for the periareolar technique. Footprint of the breast must be identified completely

Fig. 16.6 Intraoperative dissection during the periareolar technique. Non-conductive retractors are helpful to avoid thermal injury to skin edges

are then elevated to the superior aspect of the NAC. It is important to maintain the sub-NAC parenchyma for perfusion as well as to support the NAC and prevent central contour depression. At this point, the plane of dissection is transitioned more superficially to the outer surface of the breast capsule. Skin and subcutaneous flaps are then elevated off the breast capsule in all directions to the extent of the breast footprint down to the chest wall (Fig. 16.6).

The breast gland is then elevated from the pectoralis muscle with preservation of the overlying fascia. It is important that the dissection extends all the way to the marked borders of the breast in order to achieve optimal contours. After irrigation and careful hemostasis, a 15-French round closed suction drain is placed in the mastectomy cavity and secured. The wound is then closed in layers and steri-strips followed by placement of gauze and a compression vest. Drains remain for 1 week and compression is continued for 4–6 weeks. For the right patients, the periareolar technique can result in a masculine chest with nearly imperceptible scars under the areola (Fig. 16.7a, b).

Concentric Circular Technique

For patients with mild to moderate amount of skin excess and those who would like to avoid free nipple grafts, mastectomy with a concentric circular skin excision is the preferred technique. In these patients, in addition to the midline and breast footprint markings, an inner circle is drawn around within the existing NAC to be the diameter of the new NAC, usually about 2.5 cm. It can be drawn while standing but is usually redrawn in the operating room while holding tension and using a sterile US nickel or other measuring device. The outer circle is drawn while the patient is standing and using clinical judgment to determine the amount of skin to be excised. The surgery is initiated with deepithelialization of the intervening skin between the two circles. A full-thickness incision is then made through the lower half of the dermal pedicle and the mastectomy is carried out identically to the periareolar technique.

Once the mastectomy is completed, the outer circle is tailor-tacked to the inner circle, and the patient is sat upright in the operating room to assess contours. If there continues to be significant skin excess, additional skin can be removed through a variety of skin patterns including the lateral extension, a vertical pattern, or an inverted-t pattern, or a horizontal wedge of skin resection along the pectoralis inferior border. This technique can result in scars well camouflaged around the NAC (Fig. 16.8a, b).

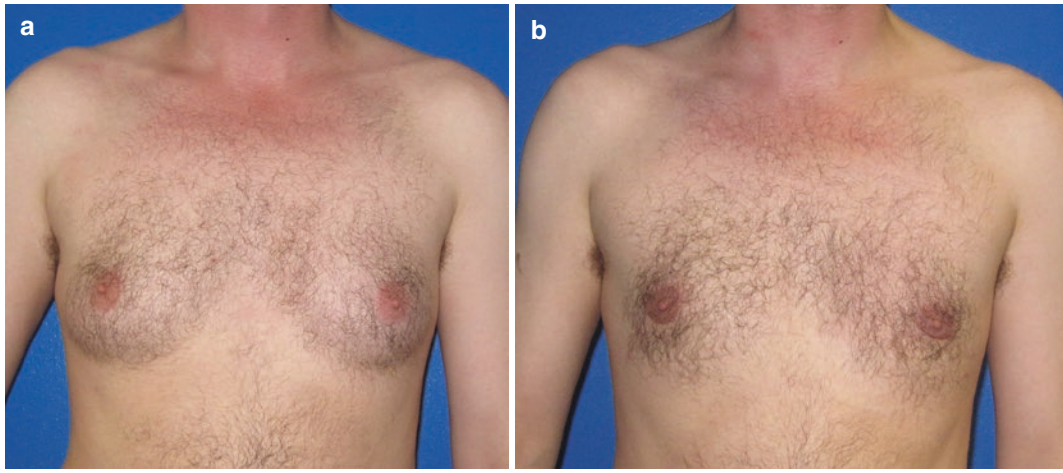

Fig. 16.7 (**a**, **b**) Before (**a**) and after (**b**) chest masculinization using a periareolar technique

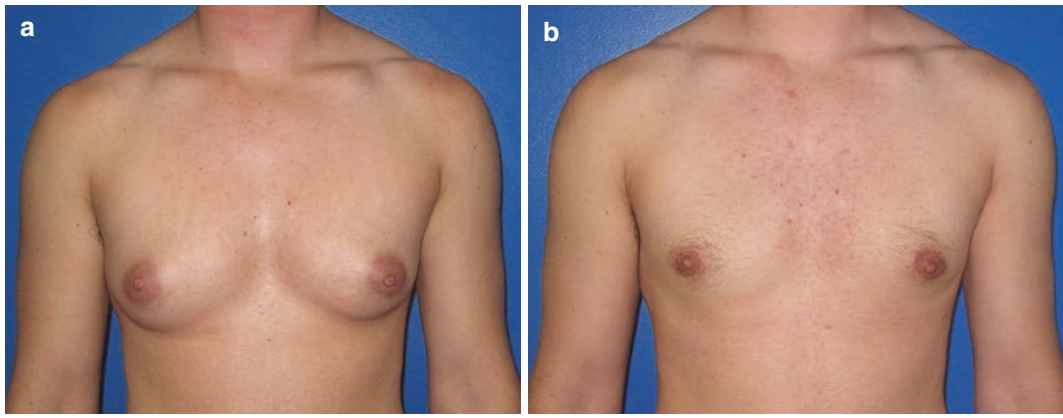

Fig. 16.8 (**a**, **b**) Before (**a**) and after (**b**) chest masculinization using the concentric circular technique

Double Incision Free Nipple Graft Technique

The double incision mastectomy with free nipple grafts is the workhorse technique for chest masculinization and is most reliable in achieving flat contours and properly sized and positioned male NACs. Markings of the midline and breast footprint are performed as in the other techniques. The lateral border of the pectoralis is marked symmetrically. Next, with downward manual tension on the overlying breast and skin meant to simulate the tension during skin closure, the inferior border of the pectoralis muscle is marked in a gentle curve. The line is transposed symmetrically to the opposite side using a ruler from the sternal notch. This becomes the superior line of the skin ellipse and will dictate final scar position. Nonanatomic scar position will result if this line is placed too high or too low relative to the muscle insertion and requires careful attention. The inferior line is then drawn by determining the amount of skin that can be removed and still close without tension. This line is typically 1–2 cm above the IMF (Fig. 16.9a–d).

The surgery begins with harvesting of the nipple grafts as either a traditional free nipple graft or composite free nipple graft based on the dimensions of the patient's NAC (description of nipple grafting techniques to follow). The harvested

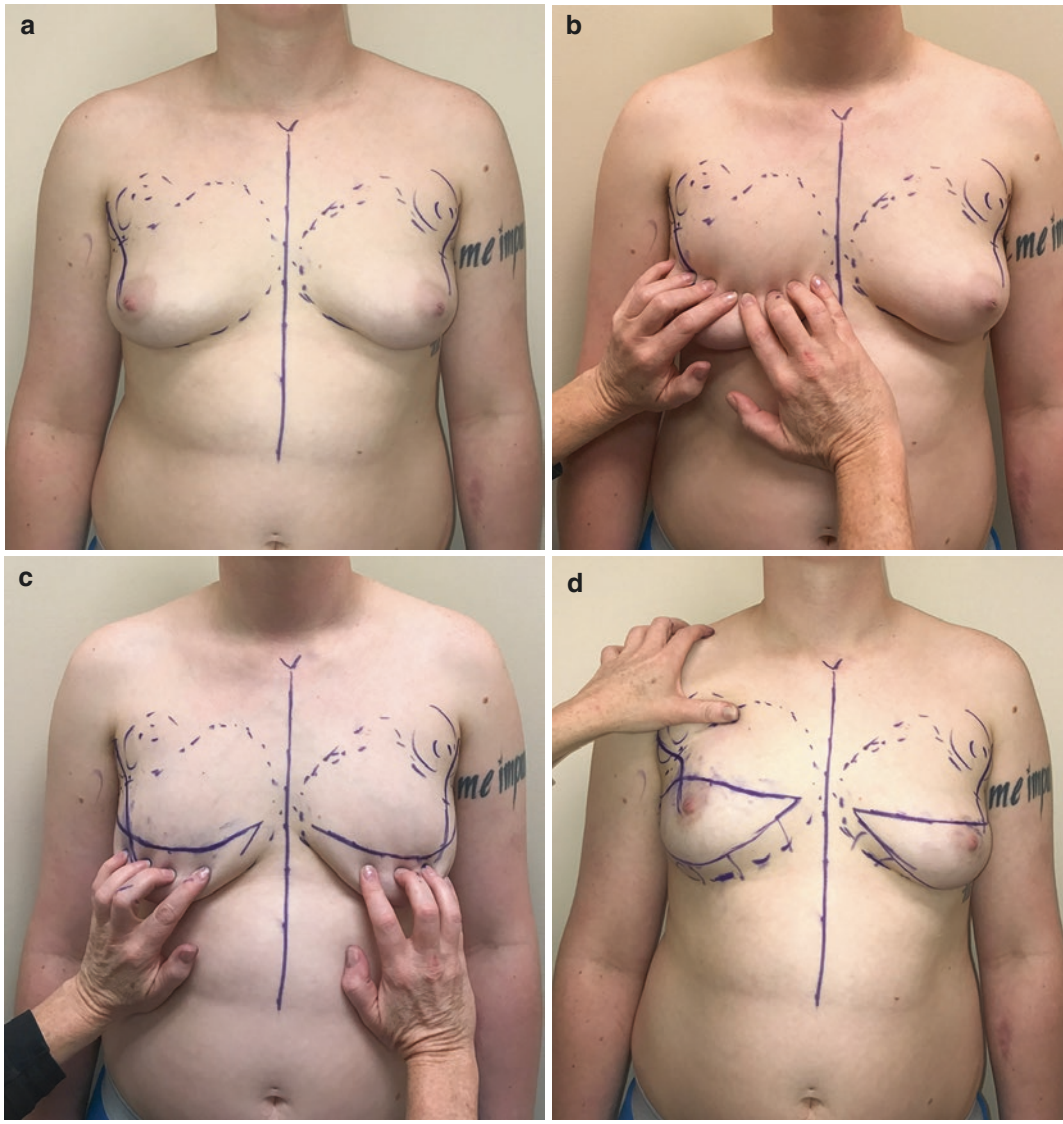

Fig. 16.9 (**a**–**d**). Preoperative markings for double incision mastectomy (**a**) marking of the midline, the lateral pectoralis border, and the breast footprint, (**b**) downward retraction to predict position of the final scar along the inferior pectoralis insertion, (**c**) symmetric superior markings along the predicted final scar position, (**d**) inferior markings determined by a "pinch" test to reach the upper line. Notice that this is above the IMF by 1–2 cm

grafts are placed on a moistened gauze on the back table for later use. The previously drawn mastectomy ellipses are then incised and carried down to the breast capsule. Skin flaps are raised in the plane separating the breast capsule and overlying the skin and subcutaneous tissue. As with the previous techniques, it is essential that the subcutaneous tissue is preserved and that the dissection plane follows the breast capsule precisely to avoid overthinning of the skin flap and a hollowed-out appearance. Firm counter-traction of the breast tissue facilitates the dissection. These flaps are elevated to the extent of the premarked breast footprint and taken down to the chest wall. It is important that the inferior skin flaps are thinned adequately and that the dissection is carried out past the marked IMF (Fig. 16.10a, b).

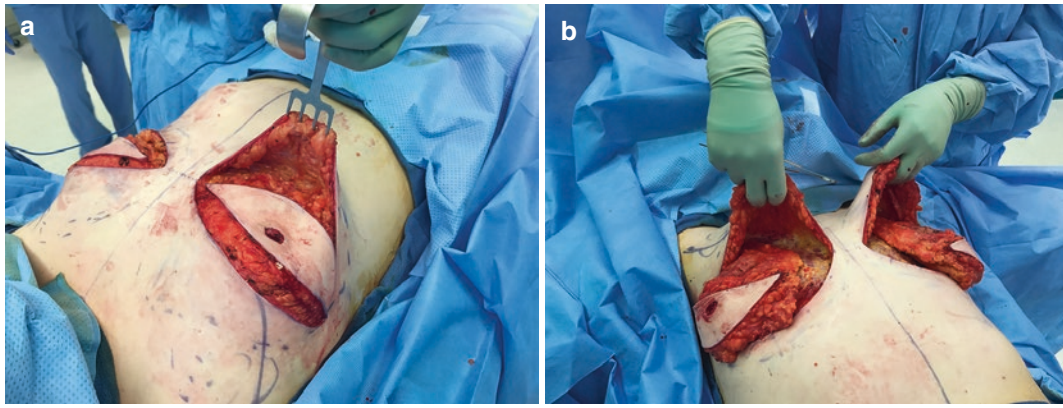

Fig. 16.10 (**a**, **b**) Elevation of skin flaps. (**a**) inferior flap and (**b**) superior flaps

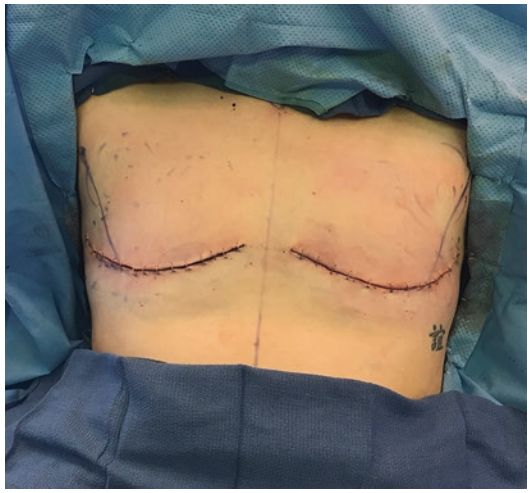

Fig. 16.11 Assessing incisions in a sitting position with tailor-tacked flaps

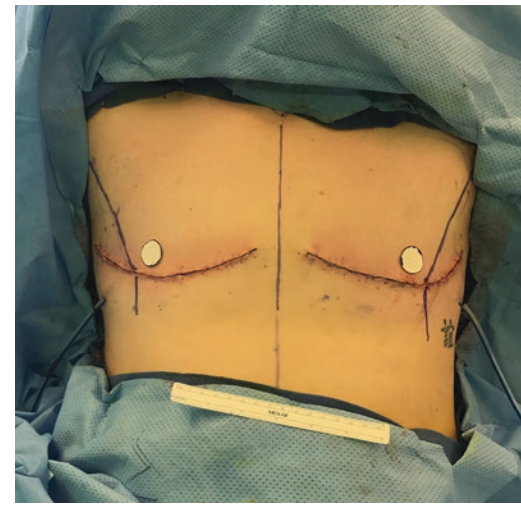

Fig. 16.12 Determining nipple-areolar position in a sitting position. Lateral marks indicate pectoralis lateral border

After the mastectomy is completed, the skin flaps are temporarily stapled closed, and the patient is then sat up to assess scar position, shape, and symmetry. Adjustments are made with the patient sitting up through a combination of tailor tacking and staples until optimal scar position is obtained (Fig. 16.11).

The patient is returned to a supine position, skin is trimmed, and hemostasis is ensured. A 15-French round drain is placed in the mastectomy cavity and secured in place. The wound is then closed in layers. At this point we proceed with free nipple grafting.

Free Nipple Grafting

After the mastectomy is completed and closed, the position for the NAC is determined. The patient is sat upright on the operating table and the lateral border of the pectoralis muscle is palpated and marked. Two 2.2 cm circular paper markers (size of a US nickel) are used to determine the NAC position. The markers are placed approximately 1.5–2.5 cm above and medial to the pectoralis borders, with final position based on body habitus and surgeon aesthetic judgment (Fig. 16.12)

[13]. The most common error is leaving the NACs too high and too medial and it is important to avoid this and position the NAC near the inferior insertion and lateral border of the pectoralis for optimal aesthetics [8, 13, 14].

Once the appropriate position has been determined, the patient is returned to a supine position. Because of the tendency for the grafted NACs to elongate in a vertical direction over time along the lines of tension, we have found that modification of the recipient site to a horizontal oval shape has been an effective method to create a final round shape. We begin by drawing a 2.2 cm circle at the optimally determined location of the NAC as described above. In order to orient the oval, a line is drawn through the circle perpendicular to the incision in the direction of greatest tension. The circle is then converted to a horizontally oriented oval with the vertical height along this line. Through experience, we have found that oval dimensions of 1.5 cm in height × 2.5 cm in width yield a nearly round NAC in most cases, but these dimensions may need to be adjusted as deemed necessary based on skin tension (Fig. 16.13). This oval is then deepithelialized for graft placement (Fig. 16.14a, b). The oval recipient site compensates for nipple graft distortion due to the direction of skin tension, with the end result being an NAC that will be more circular over time.

We use two options for free nipple grafting techniques based on the dimensions of the patient's original NAC. In cases where the original nipple papilla measures <1 cm in diameter and projection, a standard free nipple graft is performed. In this technique, a 2.2 cm marking is made around the native NAC while held on tension. It is harvested in a mid-dermal plane along the areolar portion with preservation of about 3–4 mm of nipple parenchyma to maintain some projection. If needed, a wedge of the nipple can be resected at the time of grafting to reduce the diameter (Fig. 16.15a, b). The grafts are inset with 5–0 fast gut suture and small vent holes are made for drainage.

In patients presenting with an excessively large nipple with a diameter and/or projection of >1 cm, a composite nipple-areolar grafting technique is selected. In these cases, a 2.2 cm circle is

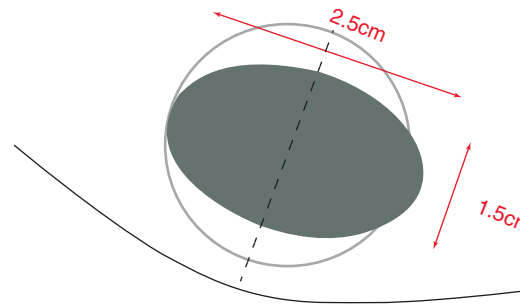

Fig. 16.13 Schematic of oval-shaped NAC recipient site

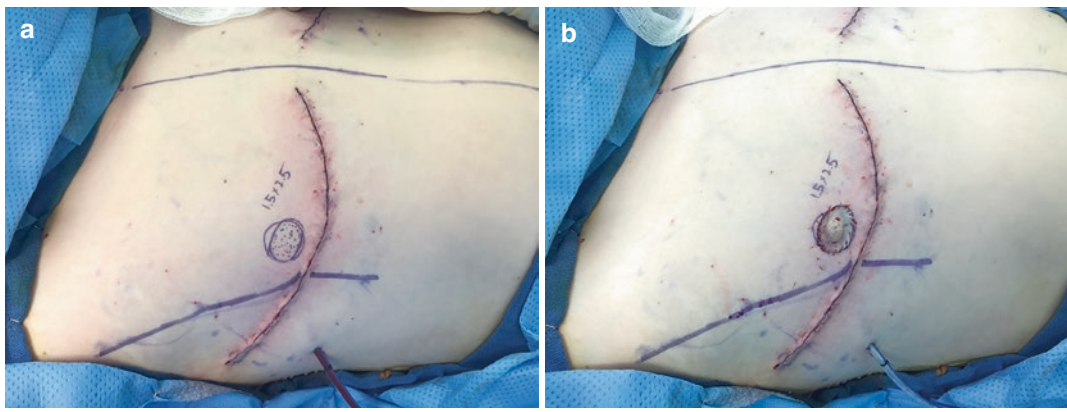

Fig. 16.14 (**a**) Circle converted into a horizontally oriented oval with dimensions 1.5 x 2.5 cm. (**b**) Oval has been deepithelialized and NAC graft is secured in place

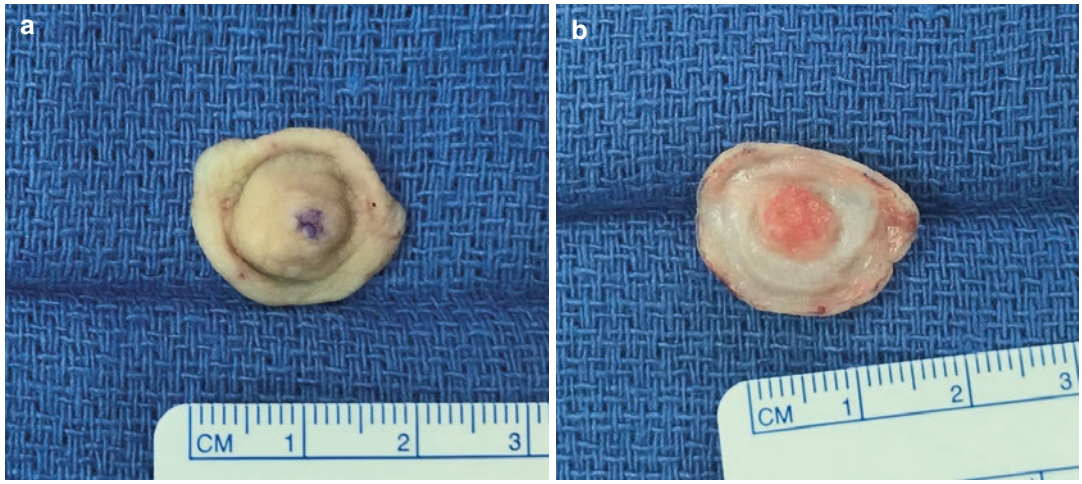

Fig. 16.15 (**a**, **b**) Standard free nipple-areolar graft after thinning of areolar portion. (**a**) Front of graft and (**b**) back of graft

harvested within the areola, and a portion of the nipple is harvested separately as a full-thickness graft. After insetting the areolar graft to the oval-shaped recipient site, a 0.5–0.7 cm circle of areolar graft is resected and the nipple graft is trimmed to size with preservation of 3–4 mm of parenchyma and inset (Fig. 16.16a–c). For both grafting techniques, pressure bolsters are placed and left in place for 1 week. As for other mastectomy techniques, gauze and a compression vest are placed (Fig. 16.17a, b).

The compression vest, drains, and if applicable, the nipple graft pressure bolster are left in place for 1 week. At the first postoperative visit, the bolsters are removed and grafts and incisions inspected. Drains are removed once they are draining less than 30 ml per day. In our experience, approximately 80 percent of patients have their drains removed at the initial postoperative visit. Patients continue to wear their compression vest for a total of 4–6 weeks. The scars for the double incision technique can be well reasonably camouflaged if placed along the inferior border of the pectoralis muscle (Figs. 16.18a, b and 16.19a, b).

Fig. 16.16 (**a**–**c**) Composite graft technique. (**a**) Harvesting the nipple and areola as separate parts, (**b**) areola inset in oval recipient site, papilla trimmed to size, and (**c**) composite NAC graft

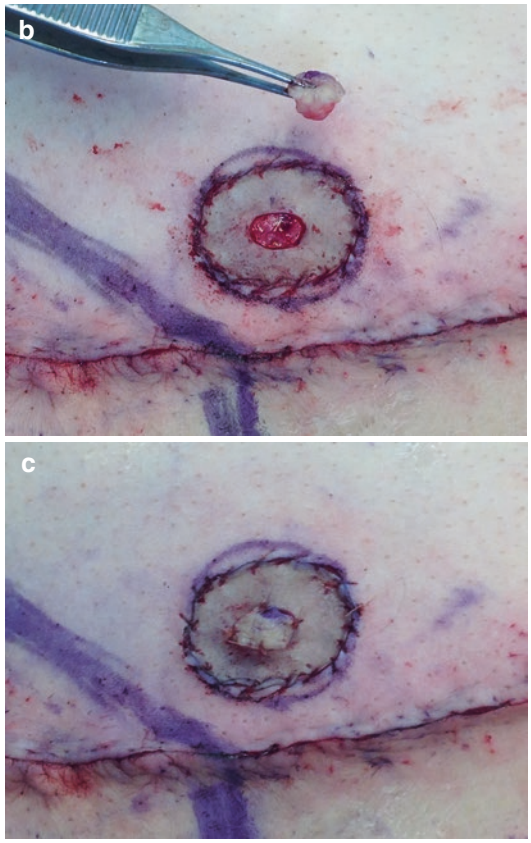

Fig. 16.16 (continued)

Another modification of the double incision technique that is sometimes advocated involves maintenance of the NAC on a dermoglandular inferior pedicle similar to that of a breast reduction [7, 14]. The primary advantage is the possibility of maintaining sensation and a more natural appearance of the NAC by avoiding a skin graft. The disadvantage is the bulge that is invariably left in the location of the pedicle which detracts from the flap contours. Advocates have stated that in heavier patients, the residual bulk is not prominent and that for some patients it is an acceptable trade-off.

Liposuction

Due to the density of breast tissue in most transmen, we have not found that this population is amendable for liposuction as the primary modality of chest reconstruction. In some patients, however, concomitant liposuction can be an important adjunct to mastectomy and skin excision. This is particularly useful in heavier patients with excess subcutaneous tissue in the lateral flank and midaxillary region. It can also be useful after periareolar or concentric circular techniques

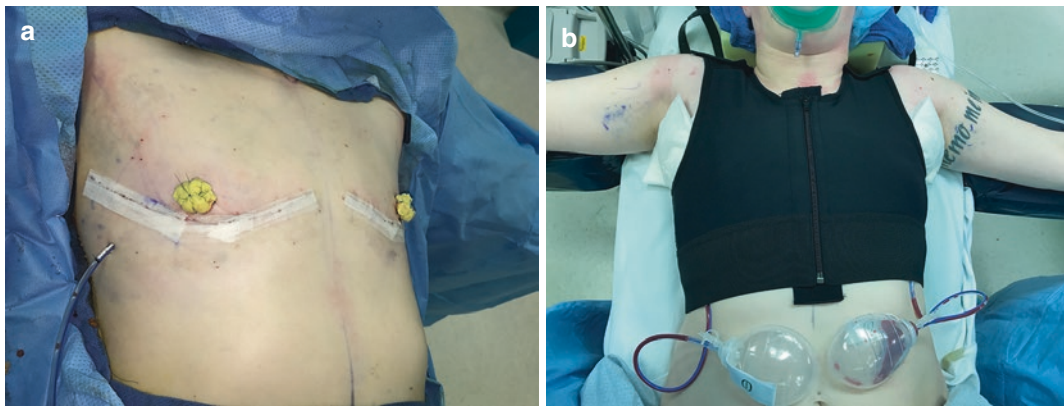

Fig. 16.17 (**a**, **b**) Left, compression bolsters placed over NACs. Right, compression vest and drains in place for 1 week post-op period

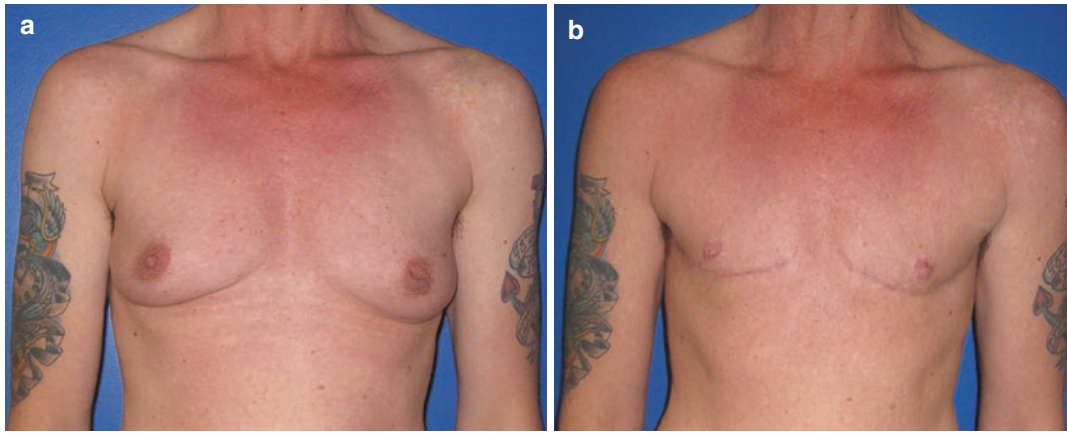

Fig. 16.18 (**a**, **b**) Before and 6 months after chest masculinization with double incision with free nipple graft technique

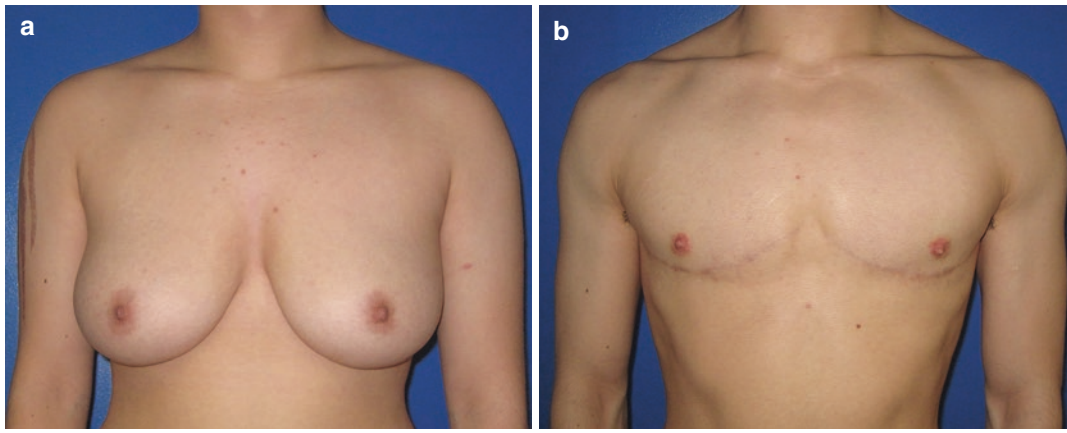

Fig. 16.19 (**a**, **b**) Before and 1 year after chest masculinization after double incision technique with free nipple graft technique

as a means to "feather out" the tissue at the edges of the resection. It is important to avoid any suctioning to the anterior portion of the mastectomy skin flaps as this will lead to a hollowed-out appearance over the pectoralis muscle. For cases in which liposuction is performed, we recommend a longer period of compression with the vest, about 6–8 weeks.

Nipple Reduction

Nipple reduction is commonly performed during the periareolar technique or as a planned secondary procedure [4]. The decision whether to delay the nipple reduction or perform it concomitantly is made immediately following the mastectomy when the vascularity and tissue trauma can be assessed. If there is any concern of local tissue stress, delay of the procedure is recommended.

There are numerous techniques described for nipple reduction, all of which can be utilized in chest masculinization surgery. We have had good success with a three-flap nipple reduction which allows for central nipple positioning and an easily tailored size. A "Mercedes" sign is drawn over the papilla apex down to the base. The three flaps are elevated, trimmed to size, and inset together with absorbable sutures. The procedure is easily performed under local anesthesia.

Complications and Revisions

Given the large surgical surface area, complications are inevitable. In the early postoperative period, hematoma is the most common complication, ranging from 5% to 15.4% [4, 7, 8, 15]. The risk of hematoma formation is increased in patients undergoing periareolar techniques likely due to the decreased visualization provided to the surgeon. Other acute complications include seroma formation and infection, which are usually able to be managed conservatively. Previous studies have shown NAC partial or complete loss as high as 2.3% to 17.9% [15–17]. We have found NAC necrosis or loss to be exceedingly rare if care is taken to thin the grafts and a pressure dressing is placed.

The rate of revision surgery for chest reconstruction ranges considerably in the literature from 8% to 40% [2, 4, 7, 8, 12, 15]. Revision rates are lower in patients with a transverse IMF incision and free nipple grafting as compared to limited scar techniques [4, 7, 12, 15]. While some of these revisions may be planned, such as nipple or areolar reduction, other unplanned revisions include scar revisions, removal or residual excess skin, and dog ear excisions. Most revisions can be performed in the clinic under local anesthesia.

Some studies have shown acute complications, such as hematoma formation as risk factors for needing revision [15]. We have found that patients who have had prior breast surgery such as breast reconstruction are at a higher risk for needing revisions. Prior surgery on the breast often leaves scars that may prevent optimal skin resection and scar placement resulting in the need for revision in the future. This also warns against performing a traditional breast reduction in known transgender patients, as in the future, it may result in the need for additional surgeries and a less optimal cosmetic result.

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Penile Inversion Vaginoplasty

14

Jess Ting and Marci Bowers

Introduction

Vaginoplasty is one of the most commonly performed gender-affirming surgeries. It is frequently the first operation sought by patients undergoing male-to-female surgical transition. It eliminates a major source of discomfort and distress and enjoys a high rate of patient satisfaction. It is a unique melding of gynecology, urology, and plastic surgery and, when well-executed, can produce an outcome that is aesthetically indistinguishable from a cis-vagina and functionally able to accommodate receptive penetrative sexual intercourse, urination while sitting, and erogenous sensation.

History

Widely credited with having been the "world's first surgical change of sex," Lili Elbe's operation in 1933 at Dresden, Germany, ultimately resulted in the patient's demise due to complications. Even prior to Lili Elbe, there are documented examples of people who were gender nonconforming. For example, eunuchs, voluntarily castrated cis males, are documented as early as Biblical times. American Indians recognized more than two genders, and people who were gender nonconforming were respected and celebrated in their communities.

Modern surgical history has evolved rapidly since its origins in inter-war Germany, particularly built upon the surgical innovations of gynecologist Georges Burou, who practiced in Casablanca in the 1950s–1970s. From the early simple penectomy-type operations, the surgical focus has paralleled social advances in feminist attitudes toward sexuality – in particular, the increasing importance of clitoral sensation and aesthetic appearance of the vulva.

Embryology

Although the layperson's perception is that male and female bodies are distinct and wholly separate universes, genitalia formation has significant homology between the sexes and is better understood as a continuum between female and male. This is best appreciated by the many biologically relevant intersex conditions ranging from lack of receptor function (androgen insensitivity syndrome, 46XY) to chromosomal abnormalities (Klinefelter's syndrome, 47XXY) to (likely) in utero estrogen exposure (hypospadias).

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Hypospadias, in particular, highlights the continuum in genitalia, whose most severe form is distinctly female in its morphology. So too, gonadal structures arise in both male and female from the gonadal ridge, the penile head and clitoris from the genital tubercle, and the labia majora and scrotum from labioscrotal folds. With the possibility of diversity within genital formation, it is hardly surprising that we are seeing unprecedented variety in degrees of "maleness" and "femaleness" on the spectrum of gender identity.

Overview of Surgical Technique

There are a variety of operative techniques for vaginoplasty. In this chapter, we focus on penile inversion vaginoplasty. The fundamental concept of penile inversion vaginoplasty is that the penile skin envelope is preserved as a pedicled skin flap and inverted into a cavity that is created between the rectum and urethra (Figs. 14.1, 14.2 and 14.3). This inverted penile skin flap becomes the lining of the vagina. Usually, the penile skin flap is extended by a full-thickness skin graft to achieve adequate depth (Fig. 14.4). The erectile portions of the penis are discarded, while a part of the glans is preserved as a sensate, island flap to become the clitoris. The urethra is shortened, and the labia majora and labia minora are formed from the skin and subcutaneous tissue adjacent to the penile base and scrotum.

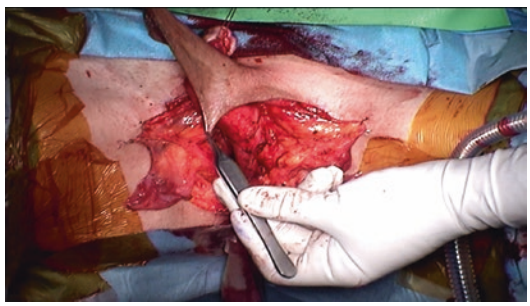

Fig. 14.1 Penile skin flap prior to inversion

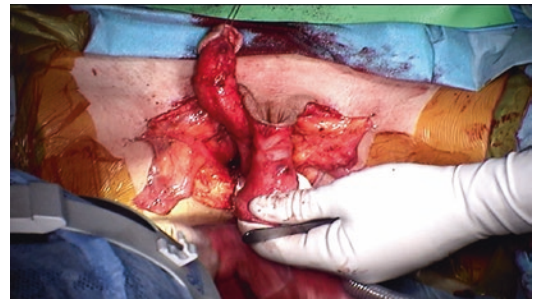

Fig. 14.2 Penile skin flap after inversion

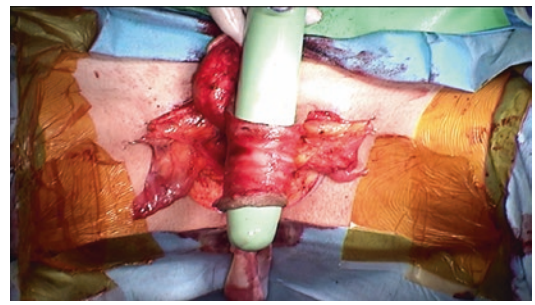

Fig. 14.3 Dilator inside inverted penile skin flap

Fig. 14.4 Scrotal skin graft

Geometric Limitations of Penile Inversion Vaginoplasty

The main geometric limitation of penile inversion vaginoplasty is that the pedicle of the penile skin flap lies anteriorly in the perineum, while the vagina is situated posteriorly. Advancing the penile skin flap posterior enough for appropriate vaginal positioning results in high tension at the

Fig. 14.5 Backcutting the skin flap prior to insert

suture line, which can cause anterior migration of the vaginal introitus over time. This results in an aesthetically undesirable posterior vaginal skin web and angulation of the introitus, both of which interfere with penetrative intercourse. To prevent this complication, the penile flap is split in the posterior midline before it is inset (Fig. 14.5). This mitigates anterior tension on the skin flap but also decreases the effective amount of penile skin available to line the vagina. This can be compensated for by increasing the size of the skin graft. In patients with a small amount of penile skin or high BMI, the entire vaginal cavity may consist of only skin graft because of this geometric limitation.

Goals

The goal of vaginoplasty is to create a vagina and external genitalia that are aesthetically and functionally similar to the cis-female genitalia. This includes creation of external genitalia such as mons pubis, labia majora, labia minora, clitoris, clitoral hood, urethra, as well as the vaginal vault itself. Functionally, the goal is to create a vagina of sufficient girth and depth for receptive penetrative sexual intercourse. Other functional goals are to create a sensate clitoris, the ability to achieve orgasm, and a shortened urethra which allows urination while sitting. The female genitalia are constructed from the existing male genital structures wherever possible. The only portions of male genitalia that are discarded are the corpora cavernosum and testes.

Indications

We follow current WPATH standards of care for vaginoplasty.

1. Persistent, well-documented gender dysphoria.
2. Capacity to make a fully informed decision and to consent for treatment.
3. Age of majority in a given country.
4. If significant medical or mental health concerns are present, they must be well controlled.
5. Twelve continuous months of hormone therapy as appropriate to the patient's gender goals (unless the patient has a medical contraindication or is otherwise unable or unwilling to take hormones).
6. Twelve continuous months of living in a gender role that is congruent with their gender identity.
7. Although not an explicit criterion, it is recommended that these patients also have regular visits with a mental health or other medical professional.

Preparation for Surgery: Medical Clearance

Patients should be medically optimized for surgery. Comorbidities should be stable and well-managed. In diabetic patients, HbA1c is checked, and if suboptimal, the patient is referred to an endocrinologist prior to surgery. Patients who are hypercoagulable are managed perioperatively in conjunction with a hematologist with the administration of antithrombotic agents. In patients who are seropositive for HIV, the viral load should be undetectable at the time of surgery, and the T-cell count should be adequate. The viral load and T-cell count are checked 2 weeks prior to surgery. In our series of patients, 2% of patients undergoing vaginoplasty were found to have occult HIV infection with high viral loads during the preoperative clearance. We ask that patients be free of tobacco consumption for 1 month before surgery.

Nicotine and cotinine serum levels are checked 2 weeks prior to surgery. We recommend a BMI under 33 for penile inversion vaginoplasty. Patients over BMI 33 are encouraged to enter a weight loss program prior to surgery. Patients with BMI over 35–37 are required to demonstrate significant weight loss prior to scheduling a date for surgery. Patients with a BMI over 40 are contraindicated for surgery due to the markedly increased perioperative risks.

Preparation for Surgery: Social Assessment

Patients' living situations and aftercare plans are assessed preoperatively. Patients should have safe, stable housing and a place to dilate. A private bathroom is ideal. Patients who climb more than one flight of stairs to get home are advised to find alternative living arrangements for the first few weeks after surgery. Patients are advised to have a companion for the first 2 weeks after surgery who can assist with the activities of daily living. Patients are visited daily in the postoperative period in their homes by a visiting nurse agency. Our program has trained local visiting nurses in cultural competency and the specific nursing needs of our vaginoplasty patients, and this has proven invaluable to our practice and our patients.

Age at Time of Surgery

In our institution, patients over the age of 18 are able to have vaginoplasty without parental consent. Patients who are 17 years old at the time of surgery are allowed to have vaginoplasty with parental consent.

Other Considerations

With the advent of pubertal suppression at young ages in the transgender population, surgeons are seeing increasing numbers of patients who present with microphallus. This presents unique challenges for vaginoplasty as the tissues used for vaginal lining – penile skin envelope and scrotal skin – are severely lacking. Options for patients with microphallus include large full-thickness skin grafts instead of the penile skin flap to line the vagina, partial-thickness skin grafts, colon or small bowel vaginoplasty, and peritoneum lining grafts.

Approximately 10% of patients in our series have had orchiectomy at the time of vaginoplasty. If the orchiectomy was done many years prior to surgery, there can be significant atrophy and shrinkage of the penis and scrotum, which makes the surgery more difficult. We advise patients not to have orchiectomy prior to vaginoplasty.

Preoperative Hair Removal

Preoperative hair removal is essential. The key areas in which to remove hair follicles are the scrotum and penile shaft. We also clear a 1/2 inch area around the base of the penis. Inadequate hair removal results in hair growth inside the vagina. This is bothersome, unsightly, and difficult to correct postoperatively. We employ several electrologists for preoperative hair removal. It may take more than five sessions, each 1–2 hours long, to achieve adequate hair clearance. We have found it helpful to inject a dilute lidocaine mixture into the scrotal skin prior to electrolysis. In addition to making the electrolysis painless, it allows the electrologist to use a higher power setting and to work more efficiently. An alternative to electrolysis, we offer patients in-house laser hair removal. We utilize a dual-wavelength Alexandrite/Nd-YAG system which works well in all skin types, including dark-skinned patients. Laser treatment is virtually painless, quick, easy to perform, and, in our experience, as efficacious as electrolysis. It can take over seven sessions in some patients to achieve adequate clearance of hair using the laser. Patients with white or light gray hair are recommended to have electrolysis. Some patients have a combination of laser treatment and electrolysis. At surgery, any residual hair follicles are excised using surgical loupes

and a small curved iris scissors. Through this multimodal approach (electrolysis, laser, and direct excision), we are able to achieve adequate hair follicle clearance in all of our patients.

Preoperative Physical Exam

There are several factors that we consider when evaluating a patient on physical exam for suitability for penile inversion vaginoplasty. The first is the size and laxity of the penile skin envelope. Penile length is a major consideration. If the flaccid penile length is under 2″, making an adequate vaginal cavity may be difficult using solely scrotal skin graft. Other graft may be needed and most of the vaginal vault will consist of graft and not skin flap. Penile girth at the penile base and glans is another important factor. Even if there is sufficient penile length, small distal penile circumference is difficult to circumvent. We incise the distal end of the penile skin tube longitudinally and inset the skin graft, as a dart, in these situations. Skin elasticity is an important factor. If the skin envelope is extremely extensible and elastic, this can compensate for short length. In patients who undergo orchiectomy many years prior to vaginoplasty, it is common to see marked atrophy of the corpora cavernosum while the penile skin envelope is preserved. Another important factor is the mobility of the base of the penis. In some patients, the base of the penis is easily mobilized posteriorly to the desired location of the vagina. This makes more of the penile skin usable for vaginal lining. In other patients, particularly young and overweight patients, the skin is relatively immobile. We make note of this on the initial exam. We have observed a relationship between a history of "tucking" and how mobile and elastic the penile skin is. Patients with many years of tucking often have excessively mobile and elastic skin. This makes the surgery much easier. We note in every initial consultation whether there is a history of penile tucking. Patients who do not tuck are encouraged to do so in the period between the initial consultation and the surgery date, which can be over a year in our practice.

Urethral Injury

It is possible to injure the urethra during the creation of the vaginal pocket. When this occurs, the injury is repaired in layer and the Foley catheter is left in for an extra week. We had two patients with urethrovaginal fistulas postoperatively. They were diagnosed by pelvic exam. Both were asymptomatic and were not treated.

Rectal Injury and Fistula

Rectal injury is possible during the dissection of the vaginal pocket. If recognized, the injury is repaired in layers. Colorectal surgery is consulted intraoperatively to assist. In the first author's series of 200 primary vaginoplasties, there were no recognized intraoperative rectal injuries. After repair, the suture line is checked for integrity by insufflating the rectum with air. Even without a recognized injury to bowel intraoperatively, it is possible to develop a rectovaginal fistula. In our series of patients, there was one patient who developed a rectovaginal fistula at 5 weeks postoperatively. There was no known rectal injury in this patient. The fistula began with the passing of flatus from the vagina and progressed to frank feces. A bimanual exam revealed a 1 cm defect 5 cm proximal to the anus. This fistula was treated by placing the patient on stool softeners. The fistula healed in 2 months, but the patient became reticent with dilation and developed shortening of the vagina. This patient will be scheduled for a deepening of the vagina.

Surgical Technique

1. Surgery is usually done under general anesthesia. In rare circumstances, it is also possible to perform surgery under spinal or epidural anesthesia.
2. Dilute local anesthesia with epinephrine is used – it decreases intraoperative blood loss, intraoperative anesthetic requirements, and postoperative pain. We use a mixture of 60 cc of 1% lidocaine with 1:100,000 epi-

nephrine and 40 cc of 0.25% Marcaine diluted with normal saline to a total volume of 300 cc.

3. The patient is positioned supine on the operating room table. After administration of general anesthesia, the patient is repositioned in the dorsal lithotomy position. Care is taken not to hyperflex the hips as this can result in neuropraxic injury of the sciatic nerve. Symmetry between the legs is verified and then the patient is prepped from umbilicus to knees. To minimize nerve compression in the arms, we fold the arms across the chest and hold them in place with a bedsheet and clamp. We use the Lindeman drape for the operative field which incorporates a sterile rectal condom (Fig. 14.6).
4. 60 cc of dilute local anesthesia is infiltrated into the scrotum and penile skin and mons pubis.
5. A butterfly-shaped incision is drawn. The lateral incisions are placed in the groin creases (Figs. 14.7 and 14.8). In a thicker or heavier patient, the scars can be placed slightly more medially to allow easier closure. Some surgeons place the lateral incisions much more medially which results in a suture line with less tension but produces scars in the center of the vulva where they are more visible. Figure 14.7 depicts the posterior aspect of the incision. The crosshair marks the position of the neovagina, which is determined by palpation. The posterior extent of the incision is placed 2 cm posterior to the neovagina position. Figure 14.8 marks the anterior extent of the incision, which usually lies just at the ventral base of the penis. The position of this anterior incision is determined by pulling the skin at the base of the penis posteriorly and estimating how much scrotal skin can be removed while still allowing the incision to close without tension (Fig. 14.9). This is one of the critical decision points in the operation. If desired, a 1–2-cm zone of skin adjacent to the posterior incision can be deepithelialized and used to underlay the posterior suture line, providing

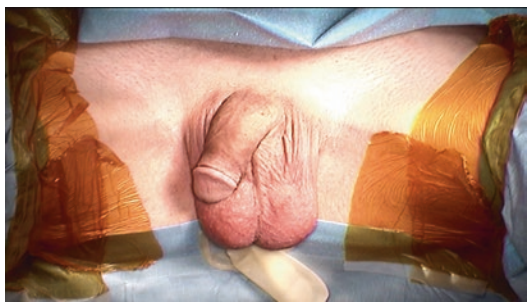

Fig. 14.6 Positioning and draping

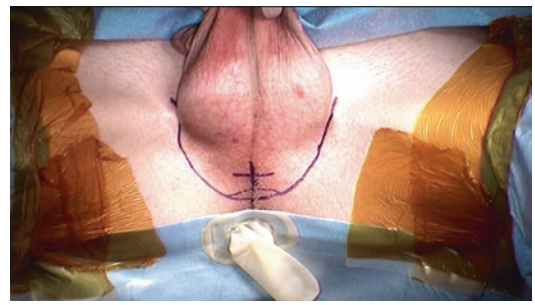

Fig. 14.7 Marking the site of the neovagina (cross)

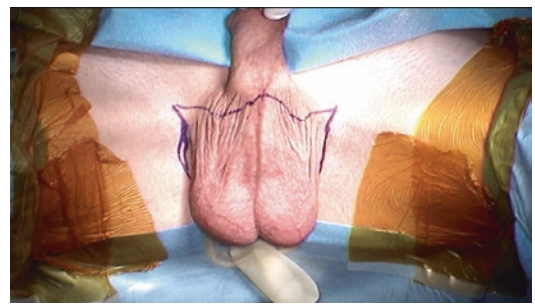

Fig. 14.8 Marking of incisions

Fig. 14.9 Checking tension on the proposed anterior suture lines

a second layer of the dermis in this vulnerable area.

6. Scrotal skin graft is harvested with the scalpel or electrocautery. In very thin patients, the skin graft can be harvested at the depth of a full-thickness skin graft. In heavier patients, varying amounts of fat can be harvested with the skin graft to prevent excessive fullness of the labia. An assistant defats and thins the skin graft on the back table using curved Mayo or Metzenbaum scissors or a scalpel. The graft can be stabilized to the back table with clamps. Residual hair follicles on the deep surface of the skin graft are excised with the iris scissors or cauterized with the Colorado tip Bovie.
7. The skin graft, which forms the deepest portion of the neovagina, is sutured around the deep end of the largest vaginal dilator using absorbable interrupted or continuous sutures to create a "sock" of skin graft (Fig. 14.10). The length of this graft can be decreased if there is a large penile inversion skin flap or increased when there is insufficient penile skin. The combined length of the penile inversion flap and the full-thickness skin graft should equal the depth of the neovaginal pocket.
8. The orchiectomy is done through the midline. Electrocautery is used to divide all but the deepest layer of tunica vaginalis. Once the correct plane is reached, it is possible to do the majority of the orchiectomy with gentle blunt dissection. The peritoneal plane is not violated, and the testes are isolated on their spermatic cords to the level of the external inguinal ring. Local anesthesia is infiltrated into the proximal spermatic cord, and the cords are suture ligated with 0 Vicryl and divided with the electrocautery. The proximal cord is inspected for hemostasis and then allowed to retract into the inguinal canal. Some surgeons will suture the external inguinal ring closed.
9. Degloving of the penis and isolation of the penile skin flap. An incision is made circumferentially around the distal penis, just proximal to the glans. A traction suture of 2–0 Vicryl is placed around the distal urethral proximal to the glans. Care is taken to preserve the dorsal vein and sensory nerves to the glans penis, as this will become the neoclitoris. Blunt dissection is used to separate the skin envelope from the deep structures of the penis. In the majority of cases, the dorsal vein is left attached to the dorsal corpora cavernosum. In a minority of cases, it is necessary to ligate and divide the dorsal vein. The separation of penile skin and deeper structures is continued until a tunnel is made to the perineal incision. The degloved penis is then delivered through the perineal incision (Fig. 14.11). Figure 14.12 demonstrates the penile skin envelope (held with the forceps) after being separated from the structural elements of the penis and before being inverted. Figure 14.13 demonstrates the penile skin envelope after inversion. The penile skin flap is inverted over the surgeon's non-dominant fingers, and any tight fibrous bands that restrict posterior

Fig. 14.10 Scrotal skin graft sutured inside-out over a dilator

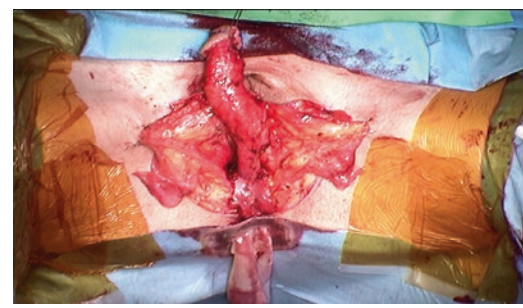

Fig. 14.11 Degloved penis. Peri-testicular fat pads are stapled to the thighs to aid visualization

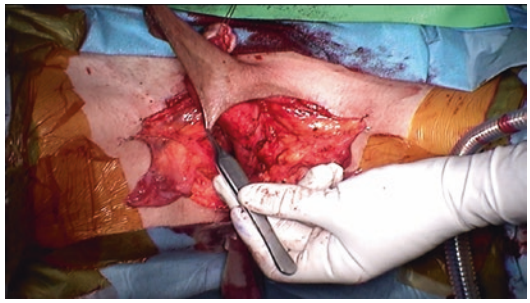

Fig. 14.12 Penile skin envelope after degloving (held with forceps)

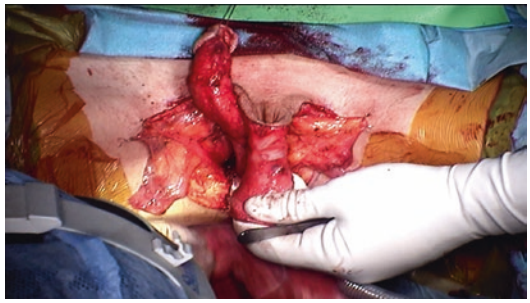

Fig. 14.13 Penile skin flap after inversion

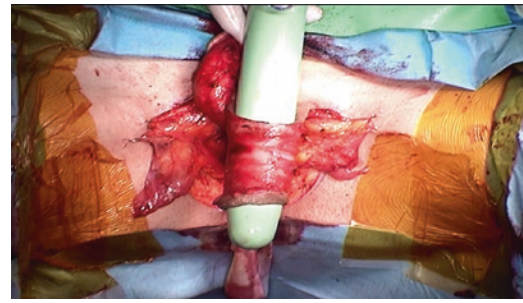

Fig. 14.14 Passing a dilator through inverted penile skin flap to check its diameter

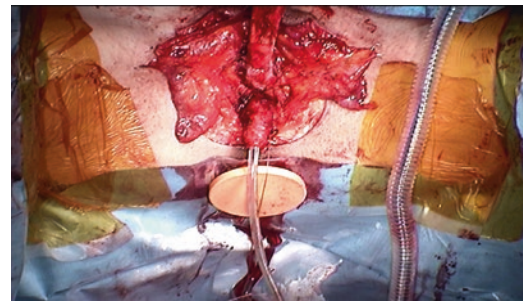

Fig. 14.15 Rectal dilator in place - shortened urethra cannulated with Foley catheter

mobility of the skin flap are divided in the posterior midline with Metzenbaum scissors. The penile skin flap is then tested for posterior mobility and undermined superiorly in the mons pubis as needed to allow the skin flap adequate mobility to be inverted into the neovaginal space. The largest dilator is passed through the penile flap to insure that the width of the penile skin tube is sufficient (Fig. 14.14).

10. Isolation of the urethra and corpora cavernosa. Soft tissues in the midline are divided with the electrocautery to expose the urethra and corpora cavernosa. The bulbospongiosus muscles are divided in the midline at their origin and then dissected off the bulbar urethra and underlying corpora cavernosa. This exposes the bulbar urethra. Local anesthesia is infiltrated into the bases of the corpora cavernosa and into the interval between the bulbar urethra and bifurcating corpora cavernosa. With finger traction on the bulbar urethra, the urethra is dissected away from the corpora cavernosa with the electrocautery. This dissection is bloodless if in the correct plane. Once sufficient length of the urethra is obtained, the urethra is divided with the electrocautery and cannulated with a 16F Foley catheter (Fig. 14.15). The bladder is emptied and then the Foley catheter is clamped. After cannulation of the urethral stump, the most proximal urethra is freed from its anterior attachments. This allows the urethral meatus to be positioned correctly in the neovagina. Insufficient dissection of these attachments results in a urethral meatus that is angulated too far anteriorly.
11. Ligation of corpora cavernosa and excision of erectile tissue of the penis. The bases of the corpora cavernosa are freed from surrounding soft tissues and then ligated with 0 Vicryl figure-of-eight sutures. The corpora cavernosa are then incised in the midsagittal plane from where the bases are ligated to the glans. With an assistant holding traction on the cut edge of the corpora cavernosum, the spongy erectile tissue inside the corpora is

Fig. 14.16 Glans penis on its neurovascular pedicle

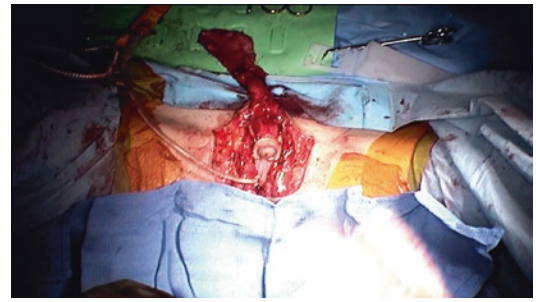

Fig. 14.18 Glans penis (neoclitoris) sutured at level of adductor longus tendon

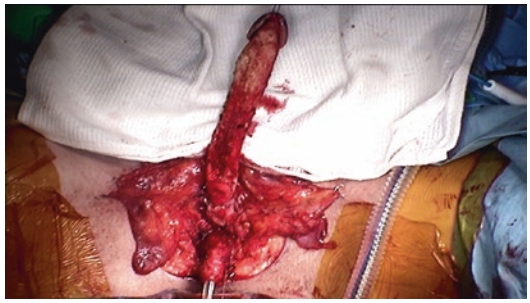

Fig. 14.17 Glans penis pedicle on stretch. Dorsal corpora cavernosa and erectile tissue have been removed

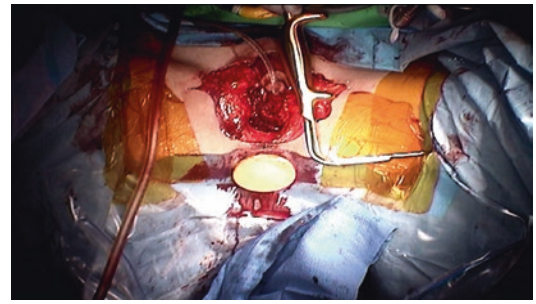

Fig. 14.19 Side view of lighted retractor used during pocket dissection

dissected away from the underside of the dorsal corpora cavernosa. At the base of the corpora cavernosa, a single artery and vein in each corpora are identified and clipped. The spongiosum tissue and ventral half of the corpora cavernosa are passed off the field. Figure 14.16 demonstrates what remains of the corpora cavernosum after removal of the urethra and spongy erectile tissue. The neurovascular pedicle to the glans penis lies dorsal to the preserved section of corpora cavernosum fascia. Figure 14.17 demonstrates the preserved portions of the corpora cavernosum and glans penis on stretch.

12. The neoclitoris is fabricated from the glans penis. Various parts of the glans can be used for this purpose. Commonly, an oval portion of the dorsal glans is preserved for this purpose, and the remainder of the glans penis is discarded. This segment of glans is imbricated on its deep surface with absorbable sutures to create projection of the neoclitoris. The pedicle to the glans is folded in half and loosely tacked to the fascia over the pubic symphysis and mons pubis. The clitoris is placed just posterior to the pubic symphysis and about 2 cm anterior to the neourethral meatus (Fig. 14.18). Alternatively, the tendon of the adductor longus can be used as a landmark for clitoral placement.
13. At this point the vaginal pocket is created (Figs. 14.19, 14.20 and 14.21). The bed is a raised and the patient placed into Trendelenburg position. A soft rubber dilator is placed sterilely into the rectum through the rectal condom (Fig. 14.22). Using an 18-g spinal needle, the plane of the neovaginal pocket is infiltrated with 150 cc of dilute anesthetic solution with 1:400,000 epinephrine. With a suture placed in the bulbospongiosus muscles placed on constant upward traction, the interval between the bulbospongiosus and superficial transverse perineal muscle is developed with Bovie electrocautery. The central tendon is usually visualized at this point and divided. This

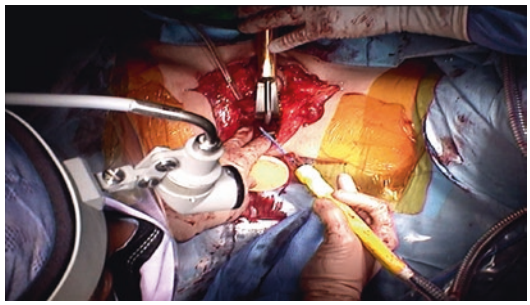

Fig. 14.20 Surgeon's non-dominant hand holds rectum out of the field

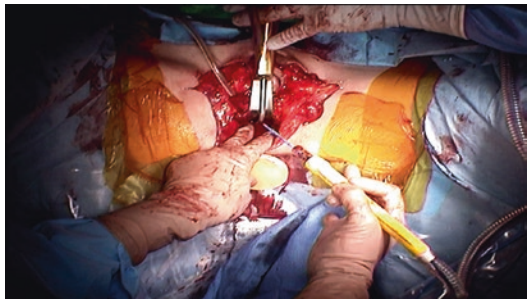

Fig. 14.21 Surgeon's view of the pocket dissection

plane can be very indistinct, and care must be taken to avoid entering the rectal wall muscles. This plane follows the bulbospongiosus muscle as it makes an almost 90 degree turn to run parallel to the rectum. This plane is avascular. If excessive bleeding is noted, it is a sign of being in the wrong plane – either the rectal wall or urethral spongy layer. With two fingers pushing the rectal wall away from the urethra, and traction on the suture in the bulbospongiosus muscle, this plane is carefully dissected with sparing use of Bovie electrocautery on low power setting and gentle finger dissection. The side wall muscles are divided almost to the level of the pelvic bones. Large vessels that are difficult to control are encountered here and may require suture ligature. Failure to adequately divide the side wall muscles will result in early postop stricture. Once the prostate is reached, the traction suture is replaced with a fiberoptic lighted retractor, and the dissection

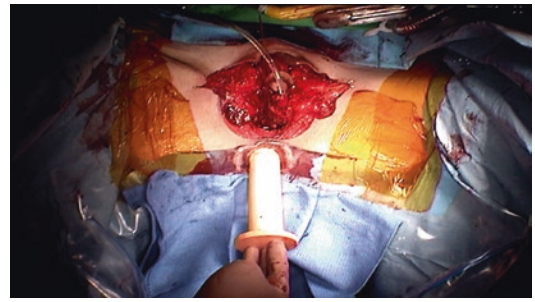

Fig. 14.22 A soft dilator is inserted sterilely into rectum

is continued just posterior to the prostate gland. The plane of this dissection can be either anterior or posterior to the prostate fascia, but in either layer, it is largely avascular. There is a prostate venous plexus that is left anterior to the dissection plane. These veins are large but do not bleed excessively. The important landmark at this point is the Foley balloon. The angle of dissection is adjusted until the dissection plane runs just posteriorly to the Foley balloon. The seminal vesicles are encountered in this region and are notable for a brownish coloration when cauterized. Throughout this entire dissection, two fingers are kept on rectum and the rectal dilator to avoid injury to the rectum. Once the balloon of the Foley is reached, the dissection plane becomes easier to visualize. As the peritoneal reflection is approached, the dissection plane becomes filmy. The dissection is continued with Bovie electrocautery until the pocket becomes too deep for any further cautery dissection. At this point, the rectal dilator is removed, and the pocket is serially dilated with the smallest to largest dilators using only very gentle pressure. It is possible to cause a full-thickness rectal tear with the dilators, so caution is needed. Our goal is to achieve a minimal depth of 6 inches. Usually 7 inches is attainable.

14. After the pocket dissection is complete, hemostasis is achieved with Bovie electrocautery. The pocket is irrigated with saline. A dilator can be left in the pocket to tamponade bleeding while the urethra is inset.

Fig. 14.23 Scrotal skin graft extension is sutured to end of penile skin flap

Fig. 14.24 Penile skin flap is split prior to insertion into the pocket. This releases tension on the skin flap

15. The urethra is divided in the ventral midline and trimmed to the appropriate length. There are two ways to suture the urethral/clitoral junction. The spatulated urethral wall can be split in the dorsal midline for a length of 1.5 cm, and the clitoris is exteriorized through this aperture and inset with 4–0 Monocryl interrupted sutures. Alternatively, the distal cut end of the spatulated urethra can be sutured end-to-end to the ventral cut edge of the clitoris.
16. The previously fabricated "sock" of skin graft is then attached to the end of the tube of inverted penile shaft skin with interrupted absorbable sutures (Fig. 14.23) to create the entire lining of the neovagina. In this fashion, the neovagina is lined with a combination of vascularized skin flaps and skin grafts. The proximal ventral midline of the penile flap is split until the anterior tension on the dilator is sufficiently released (Fig. 14.24). Sometimes, this split of the penile flap reaches almost to the level of the skin graft.
17. The composite of penile inversion skin flap and skin graft is then inverted into the vaginal pocket over a dilator. There should be minimal tension on the penile skin flap when the dilator is fully inserted. Too much tension indicates that the penile flaps need to be split further. This can be done in millimeter increments with the Bovie while observing the angle and tension on the dilator. The surgeon will know sufficient tension has been released when the dilator lies perpendicular to the plane of the perineum without any manipulation. There is a balancing act between tension on the skin flap and depth of the vaginal lining. Too much splitting of the penile skin flap can result in a vaginal skin envelope that is too short. Too little splitting of the penile flap will result in excessive tension of the posterior incision. This leads over time to anterior migration of the posterior fourchette of the neovagina and the formation of a posterior "skin bridge."
18. The posterior edge of the inverted penile flap is sutured to the midline of the perineum. The vaginal pocket is packed with vaginal packing that is coated with antibiotic ointment.
19. At this point the clitoris and urethra must be exteriorized and inset. The skin is incised in the midline with the scalpel, and the clitoris and urethra are identified through this opening. The end of the Foley catheter is delivered through this opening, and then the edges of the urethral meatus, spatulated urethra, and clitoris are inset circumferentially in this aperture with interrupted and continuous sutures.
20. The groin incisions are tailor-tacked with staples. Dogears are trimmed and then the incisions are closed in layers with absorbable sutures (Fig. 14.25).
21. The clitoral hood and labia minora can be plicated with running or interrupted horizontal mattress sutures.
22. Penrose or suction drains are placed through the incisions.
23. A pressure dressing or negative pressure wound dressing is applied (Fig. 14.26). The patient is extubated and taken to the PACU.

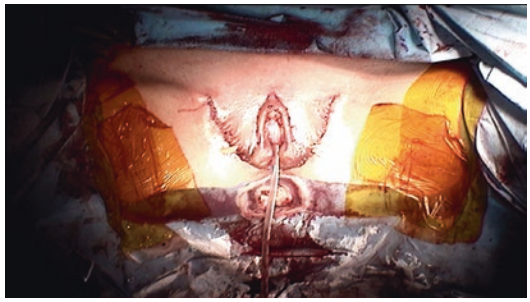

Fig. 14.25 After skin closure

Fig. 14.26 After placement of negative pressure dressing

Postoperative Considerations

Dilation is critical for the success of penile inversion vaginoplasty. It must be done 2–3 times per day for the first year. Skipping even a few days of dilation can result in strictures and loss of depth. After 1 year, the dilation schedule will depend on each individual patient's tendency to form strictures. Some patients can dilate once per week or less and still maintain the depth and width of the vaginal cavity. Others may need more frequent dilation. Regular and frequent penetrative intercourse can lessen the need for dilation after the first year.

A Foley catheter is placed intraoperatively and kept in postoperatively until the packing is removed.

Vaginal packing is essential to immobilize the internal skin graft and allow good "take." Vaginal packing also tamponades bleeding. We use cotton vaginal packing imbued with metronidazole ointment. The vaginal packing remains in place for 1 week.

Our preferred postoperative dressing consists of a negative pressure wound dressing set to constant pressure at −60 mmHg. The NPWT immobilizes the surgical site and allows for safe ambulation at postop day 1. Pain is lessened by the splinting and immobilizing of the skin by the NPWT dressing. Anecdotally, the use of NPWT decreases bleeding and oozing and dramatically decreases swelling. With use of the NPWT, we were able to switch from closed suction drains to Penrose drains with no loss in efficacy and a significant decrease in drain discomfort. We have also anecdotally observed a decrease in early wound dehiscence with the NPWT. We use a U-shaped sponge so that there is no compression of the pedicle of the penile inversion flap.

Complications

Wound dehiscence: In our series of patients, wound dehiscence occurred between weeks 1–4 postoperatively and varied from a small posterior dehiscence (<1 cm) to subtotal dehiscence of the entire suture line. Risk factors for dehiscence include obesity, smoking, excessive activity levels, and a deficiency of penile skin resulting in increased wound tension. We have also had patients who were dilating in their posterior incision instead of inside the vaginal cavity. Attempts to suture wound dehiscences were uniformly unsuccessful and resulted in reopening of the wounds within a few days. We now treat wound dehiscences conservatively. Even large wound dehiscences heal by secondary intent with few long-term sequelae. With the institution of negative pressure wound therapy postoperatively, we have experienced a decreased incidence of wound dehiscence and, when they do occur, a decrease in severity.

Bleeding: In our series of 150 primary vaginoplasties, there were 3 episodes of bleeding requiring intervention. None occurred in the immediate postoperative period. All three patients were transfused (2u, 4u, 4u). Two occurred at postop week 3 and were temporally related to dilation. These two patients required return trips to the OR where a bleeding vaginal sidewall vessel was

found and ligated. One bleeding episode occurred spontaneously at week 4. The patient was seen at an outside institution and transfused in the emergency department. She was transferred to our institution where she was treated conservatively with no recurrence of bleeding.

Edema: Edema of the labia majora, labia minora, and periurethral tissues is common. Since we instituted use of negative pressure dressings for the first week postoperatively, the rate of edema decreased dramatically.

Hematoma: There were three episodes of clinically significant hematomas – two in the labia majora and one in the mons pubis. Both labial hematomas drained spontaneously and did not require a return to the OR. The hematoma of the mons pubis was drained by a pigtail catheter placed by interventional radiology at postop week 5. Swelling of the mons pubis is very common postoperatively, and it is likely that many of these patients have occult hematomas in the mons. This swelling resolves quickly in almost all cases.

Clitoral loss of sensation occurred in 2 out of 150 primary vaginoplasties. In both cases, complete sensation returned by week 6 postoperatively. It is much more common to have hypersensitivity of the clitoris. We counsel our patients to begin clitoral stimulation after the first week to minimize hypersensitivity.

Clitoral necrosis: Several episodes of sloughing of the superficial epidermis (epidermolysis) were noted. These were self-limited with complete healing and full erogenous sensation. No patient experienced complete clitoral necrosis.

Granulation tissue: Granulation tissue is common after vaginoplasty along the periurethral suture line or inside the vaginal vault on the suture lines of the skin graft. This tissue can cause bleeding, discomfort, and malodorous drainage. Granulation tissue can be treated by chemical cauterization with silver nitrate sticks. Repeat treatments may be needed. Protuberant or pedunculated pieces of granulation tissue can be trimmed with scissors prior to cauterization. Overtreatment of granulation tissue is to be avoided as we have seen several instances of vaginal strictures that began after cauterization of long-standing granulation tissue inside the vaginal vault.

Skin necrosis: Necrosis of the labia minora occurred in a small percentage of patients. Typically, the necrosis was segmental and unilateral. We now plicate with interrupted mattress sutures tied loosely and have noted a decreased rate of labial necrosis. Other causes of labia minora skin necrosis include high tension on the skin flap and extensive undermining in the mons pubis under the penile skin flap. There were two cases of extensive necrosis of the penile flap that required intervention. The first patient had a micropenis and high wound tension. The second patient was noncompliant with postop instructions and traveled out of state on POD 8. Both patients required a return to the OR where large segments of labia majora were debrided and resurfaced with split-thickness skin grafts. The vaginal cavities in these two patients, which consisted mostly of skin graft, remained intact.

Posterior skin web: Webbing occurs when anterior tension on the penile skin flap is not adequately mitigated at the time of closure, causing the vaginal introitus to gradually migrate anteriorly over the first several weeks to months postoperatively. It was more common in patients with smaller penile skin envelopes. This anterior migration of the vaginal introitus shortens the external vulva and makes vaginal penetration difficult. The web is easily corrected under local anesthesia in the office by dividing the skin web axially in the posterior midline and closing transversely, excising dogears anteriorly along the ridge of the labia minora.

Stricture: Internal vaginal stricture occurred at all phases of recovery – as early as 1 month postoperatively and as late as 1 year postoperatively. In most cases, the stricture occurred after a break in the dilation schedule. Many strictures occurred at the suture line between the penile flap and skin graft and ranged from subclinical, notable only on pelvic exam, to complete closure of the vagina. We modified our technique by making the interface between the penile skin flap and skin graft oblique (see photo). Surgical correction of these strictures was usually possible. These were done under general anesthesia with a full bowel prep. Patients were counseled about the risk of rectovaginal or urethrovaginal injuries and fistulas. After a bowel prep, the

strictures were released at 3 o'clock and 9 o'clock with Bovie electrocautery. These release sites were allowed to heal by secondary intent and reepithelialization. Almost all patients with strictures (except for the mildest) also suffered loss of depth, possibly related to difficulty dilating past the stricture.

Loss of depth: It is common for patients to experience 1/2–1 inch of lost depth in the first 2–3 months postoperatively. This was often related to decreased edema rather than a loss of depth of the internal vaginal cavity.

Loss of labia minora definition: As edema resolves and tissues stretch in the months after surgery, it is not uncommon for the labia minora to become lax and redundant and lose definition. While some skin laxity is necessary for natural pleating of the labia minora to occur, too much skin laxity has deleterious effects on labial definition. An overabundance of skin can be addressed by excising grossly redundant labial skin and recreation tension in the anterior-posterior vector. Alternatively, if the skin folds are present but there is too much subcutaneous adipose tissue to allow fine crepe-like labia minora, it is possible to debulk the subcutaneous adipose layer with a 2- or 3-mm liposuction cannula. Once the appropriate amount of skin and subcutaneous adipose tissue have been arrived at, plication sutures of long-lasting monofilament material can be helpful in defining the folds of the labia minora. In this setting, unlike in the primary vaginoplasty, there is little to no risk of skin necrosis, so these plication sutures can be placed aggressively and in multiple layers if needed.

Misdirection of urinary stream: Failure to adequately release the fibrous adhesion anterior to the bulbous urethra can result in anterior angulation of the urinary stream. Patients report urinating outside of the toilet bowl when sitting. Correction of this condition requires surgical release and repositioning of the urethral meatus.

Excessive erectile tissue: Failure to completely remove erectile tissue from within the corpora cavernosum or from the bulbous urethra results is excessive swelling during arousal. This is unsightly and painful. If the residual erectile tissue is located around the urethra, the urethral meatus will protrude like a proboscis during arousal. This erectile tissue can narrow the vaginal vestibule and interfere with penetration. Erectile tissue left on the clitoral pedicle results in painful swelling in the mons pubis. This can be addressed surgically. After placement of a Foley catheter, the periurethral incision is opened and spongy and erectile tissue is resected with electrocautery.

MLD (Musculocutaneous Latissimus Dorsi) Phalloplasty

18

Rados Djinovic

Introduction

Gender confirmation surgery in transmen presents the most demanding form of genital reconstruction. It includes the removal of female genitalia in addition to the creation of male genitalia. The penis has unique characteristics and complex anatomy, and the creation of a neophallus using present surgical techniques is still far from ideal. In spite of significant improvements in aesthetic and functional results (regarding voiding and sexual function), the creation of a "normal" penis in both the flaccid and erect states and also possessing erogenous sensation remains limited. Complication rates remain high, and this encourages us to continue to strive for additional methods and techniques.

The Russian surgeon Borgoras performed the first total phalloplasty using an abdominal pedicled flap in 1936 [1]. This event stimulated other surgeons to search for better solutions, and multiple techniques using free or local flaps were developed [2–6]. However, none of these techniques were able to meet all of the goals of total phalloplasty, i.e., creation of a normal-size penis that enables safe prosthetic insertion, a good aesthetic appearance, hairless and normal skin color, good tactile and erogenous sensation, a competent neourethra with the meatus at the top of the glans, and acceptable donor site morbidity.

The most widely used flap for total phalloplasty is the radial forearm flap [2, 4]. However, there are many limitations of the forearm flap, including an unsightly donor site scar, frequent urethral complications, a small size that may limit safe prosthesis insertion, a soft consistency, and, oftentimes, pale skin. For these reasons, we searched for additional solutions. We began with the musculocutaneous latissimus dorsi (MLD) free flap, and we believe this procedure can satisfy most of the above-mentioned requirements. The latissimus dorsi is a reliable flap and is often used in plastic surgery for a wide array of indications. In urology, the functional latissimus dorsi flap has been used for atonic bladder to aid with better bladder emptying [7–9]. The latissimus dorsi flap has suitable anatomy (i.e., size, volume, and length of the neurovascular pedicle) to meet the aesthetic and functional needs of penile reconstruction. This flap can be also used for penile reconstruction in the pediatric population [10].

Patients and Methods

Between February 2005 and June 2017, 259 total phalloplasties using the musculocutaneous latissimus dorsi (MLD) flap were performed in transgender individuals between the ages of 18 and

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61 years (mean 27 years). Phalloplasties secondary to other indications were excluded. All patients were preoperatively evaluated by a qualified psychologist/psychiatrist and were on hormone medications for at least 6 months prior to surgery. A necessary precondition for this technique is a normal or slightly increased BMI (body mass index), so as to avoid the creation of a too thick neophallus and difficult urethral tubularization in the second stage.

Hormones are discontinued 1 week before the phalloplasty and resumed no sooner than 3 weeks following surgery. The donor site is prepared preoperatively with skin massage using topical emollients at least 1 month before surgery. We believe that this helps to improve skin elasticity and direct donor site closure. In six obese patients who did not lose weight prior to surgery, donor site liposuction was performed at least 3 months before surgery in order to decrease flap thickness and enable safe flap tubularization. In some patients, liposuction of the neophallus was performed following the first stage.

Surgical Anatomy

The musculocutaneous latissimus dorsi flap, first described by Baudet [11], is dependable and versatile for free tissue transfer: it has a large surface area and is easily elevated based on the thoracodorsal artery. The thoracodorsal artery, arising from the subscapular artery, provides a large, long, and reliable pedicle [12–14]. 3–5 cm after leaving the axillary artery, the subscapular artery typically divides into two branches – the circumflex scapular and the thoracodorsal artery. The thoracodorsal artery continues downward and is the dominant vessel supplying the flap. There are usually two vena comitantes accompanying the artery. These comitantes join to form a single, large thoracodorsal vein prior to entering the subscapular vein. While there are many vascular branching patterns, these patterns do not tend to affect flap elevation. The thoracodorsal nerve, a branch of the posterior cervical cord, innervates the latissimus dorsi muscle.

The neurovascular hilum is positioned approximately 8–9 cm from the axillary artery and enters the deep surface of muscle 1.5–3.0 cm medial to its anterior border. The neurovascular structures typically bifurcate and run together on the deep surface of the muscle: one branch runs vertically, parallel to the anterior border of the muscle, while the other branch runs transversely, parallel to the superior border of the muscle.

A large musculocutaneous flap, up to 18 cm wide and 28 cm long, can be raised on a 3–4 cm strip of muscle after dividing several reliable perforators over the anterior intramuscular branch. Also, only skin flap without muscle can be raised by careful mobilization of the pedicle from the muscle.

Surgical Technique

Total phalloplasty using an MLD flap is performed in three stages (Table 18.1).

Over the last 9 years, we perform the first stage, flap transfer, concurrent with (a) removal of the female genitalia (transvaginal hysterectomy with bilateral adnexectomy, colpocleisis), (b) 5–6 cm urethral advancement, (c) perineoplasty, and (d) scrotoplasty. In our initial experience, we performed a total vaginectomy (including removal of the vaginal muscle), but we abandoned this due

Table 18.1 Surgical stages of total phalloplasty using musculocutaneous latissimus dorsi flap

Stages	Surgeries	Time between stages
First stage	Transvaginal hysterectomy, adnexectomy colpocleisis, proximal urethroplasty, perineoplasty and scrotoplasty. Neophallus creation using musculocutaneous latissimus dorsi free flap with first stage urethroplasty	
Second stage	Second stage urethroplasty: neourethral plate tubularization, implantation of testicular implants	6 or > months
Third stage	Penile prosthesis implantation	6 or > months

to problems with bladder and rectal stability secondary to loss of vaginal muscle support. To address this problem, we now remove only the vaginal epithelium and obliterate the resulting cavity with a continuous spiral suture.

Following this portion of the procedure, the patient is repositioned into lateral decubitus. Positioning is aided with the use of beanbags; the upper torso is placed in a full lateral position at 90°, and the pelvis is tilted at 20–30° to provide access to the groins. This allows simultaneous flap harvest and recipient site preparation. Care is taken that there is neither excessive, nor prolonged abduction of the upper shoulder during dissection. It is advisable to harvest the flap on the nondominant side of the arm.

Flap harvest begins with marking of the anterior and superior muscle border (Fig. 18.1). The projected course of the thoracodorsal artery is outlined, and the flap is designed with its base positioned over the hilum and extending 6–7.5 cm on either side of the artery. Flap dimensions are created according to the patient's goals and the thickness and distribution of subcutaneous fat, with the goal of normal adult penile size: 12–15 cm in width and 13–18 cm in length.

Flap elevation begins with incision of the anterior skin margin down to the deep fascia overlying the serratus anterior muscle; a plane is developed between the latissimus dorsi and serratus muscles, using a combination of sharp and blunt dissection. The skin of the flap is divided inferiorly and medially, cauterizing 3–4 large posterior perforating vessels originating from the intercostal vessels. The flap is elevated proximally to expose the neurovascular pedicle.

The amount of muscle harvested around the vascular pedicle depends upon flap thickness – in thin patients, more muscle is harvested and vice versa. The pedicle is identified and dissected proximally to the axillary vessels (Fig. 18.2). All major branches are identified and ligated using monofilament 5–0 and 6–0 prolene/PDS ligatures, while small branches are cauterized. The thoracodorsal nerve is identified and proximally isolated from the vessels for a length of 5–6 cm. During dissection, special care is taken to avoid injury of the long thoracic nerve, which can cause winging of the scapula.

The neophallus is created while the flap is perfusing on its vascular pedicle: the flap is then tubularized leaving a 3–4-cm-wide muscle surface

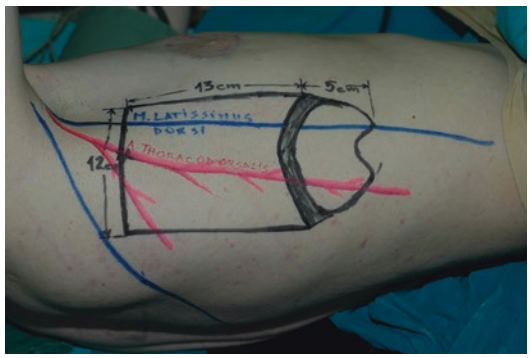

Fig. 18.1 Musculocutaneous latissimus dorsi flap design

Fig. 18.2 Flap elevation on a long neurovascular pedicle

exposed ventrally. In patients who do not request urethroplasty/urethral lengthening, the flap is completely tubularized (Fig. 18.3). Prior to transferring the flap, unfractionated heparin is administered intravenously. The subscapular artery and vein as well as the thoracodorsal nerve are divided at their origin, in order to achieve maximum pedicle length and vessel diameter. The donor site defect is closed either directly or using one or two local rotational flaps (Fig. 18.4a, b). The use of a split-thickness skin graft for donor site closure was abandoned due to nonsatisfactory aesthetic results.

Concurrent with the flap harvest, a second surgical team prepares the recipient site – superficial femoral artery, saphenous (or other local) vein, as well as the ilioinguinal nerve. These are dissected and mobilized through an oblique inguinal incision. A Y-shaped incision is made on the pubis for placement of the neophallus, and a wide subcutaneous tunnel is created between the two incisions. This allows for pedicle transfer from the pubis to the groin. The neophallus is fixed to the recipient area, and microsurgical anastomoses are performed under loupe magnification between the femoral and subscapular artery (end-to-side)

Fig. 18.3 Onsite neophallus creation, including glans

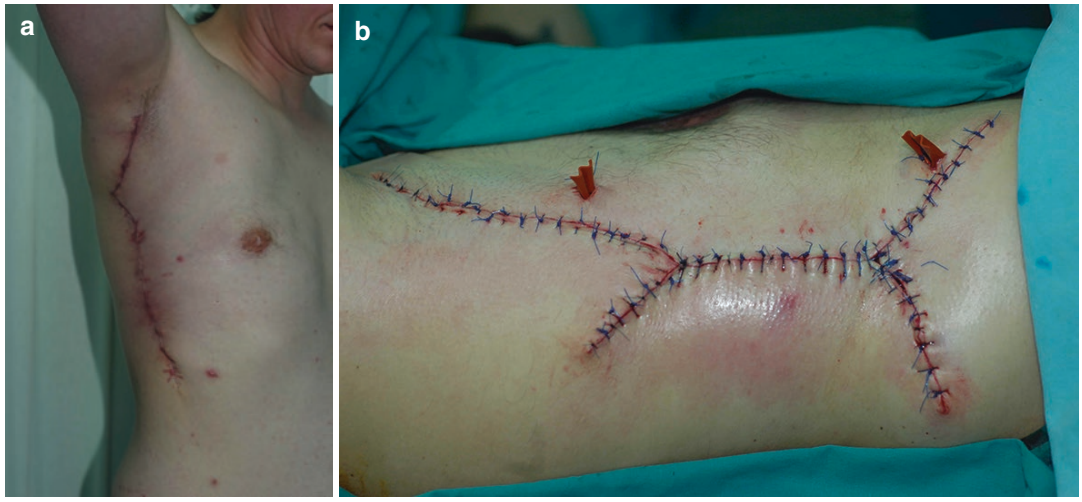

Fig. 18.4 (**a**) Direct donor site closure. (**b**) Donor site closure using two rotational flaps

Fig. 18.5 Flap transfer to the pubic region

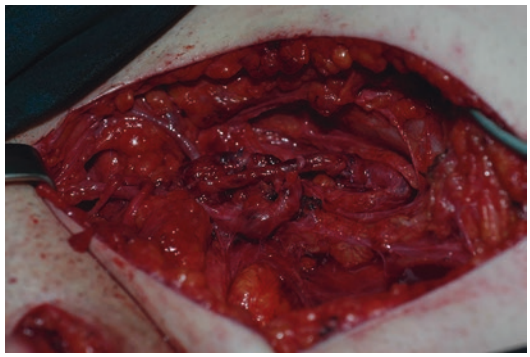

Fig. 18.6 Microsurgical anastomoses

and between the subscapular and saphenous vein (end-to-end) using 7/8–0 Prolene sutures (Fig. 18.5). The epineural microneurorrhaphy is then completed between the ilioinguinal and thoracodorsal nerves (Fig. 18.6).

The previously extended proximal urethra is joined with the neourethral plate on the ventral surface of the neophallus – the proximal portion is formed by a flap from the labia minora, and the distal portion is constructed with a split-thickness skin graft (STSG) often from the contralateral labia minora. On occasion, a skin flap from the clitoral and labia minora skin can be sufficient to cover the entire ventral neophallus (Fig. 18.7). The neurovascular bundle of the clitoris is preserved, and the clitoris is mobilized and fixed at the base of neophallus allowing for stimulation during sexual intercourse. A 14-French Foley catheter is inserted for 2.5–3 weeks. The neophallus is fixed in an elevated position for 7 days using a specially constructed dressing. This positioning is important to prevent flap kinking. Flap viability is assessed by clinical examination (i.e., skin color, turgor, and capillary refill).

Fig. 18.7 Ventral flap covering with long labia minora/clitoral skin flap

The second stage is performed at least 6 months after the first surgery. This includes a urethroplasty performed by tubularization of the previously created neourethral plate. The urethra is constructed over a 14 silicone Foley catheter (Fig. 18.8a, b). In the majority of patients, the neourethra is joined with the proximal, pars fixa, of the previously constructed urethra. However, in situations where there is a high-risk for urethral stricture, a perineal fistula is left in place. The penile urethra is dilated for a few months, and the two urethral segments are joined during the third stage. During the urethral reconstruction, care is taken to avoid overlapping urethral and skin suture lines.

The glans is designed and created over the distal 4–6 cm of the flap. The glans is constructed by tangential skin incisions which are joined subdermally with the proximal phallus (Fig. 18.9). Testicular implants are usually implanted during this stage. However, in individuals where there is a concern of urethral suture line compression, testicular implants are placed in the next stage. A suprapubic catheter remains in place for 3–4 weeks, at which time patients start to void.

The penile prosthesis is placed during the third stage using an infrapubic approach. In the major-

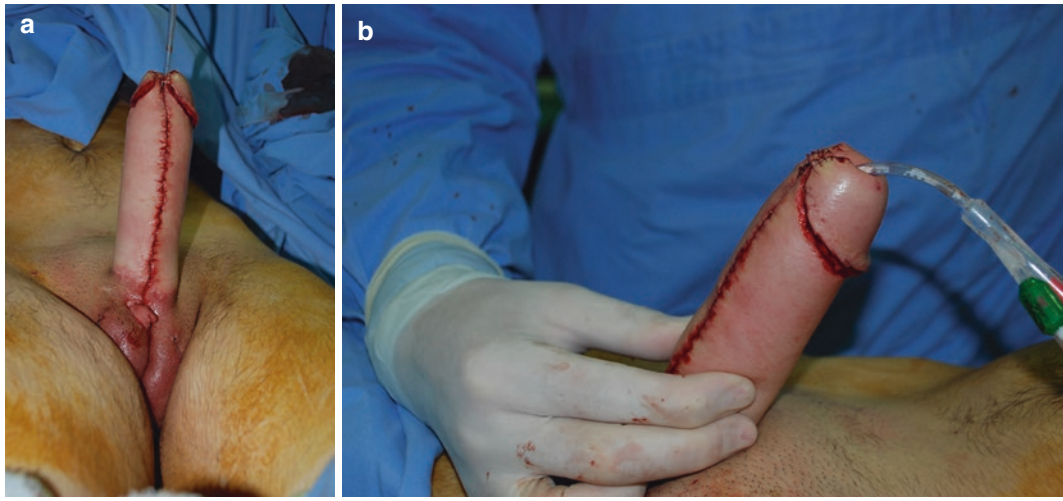

Fig. 18.8 (**a**, **b**) Tubularized urethroplasty with glans creation in the second stage

Fig. 18.9 *Glansplasty*

ity of patients, a three-piece inflatable prosthesis with two cylinders is chosen. In order to place the prosthesis, the flap is partially detached from the pubis, on the contralateral side from the pedicle. Using Hegar dilators, two channels are created at the border between the muscle and subcutaneous fatty tissue. Care is taken to avoid both urethral damage and distal placement of the cylinders. Infrapubically, channels are developed parallel to the pubic rami to allow for prosthetic fixation. Proximal and distal neotunica sleeves are created from hernia mesh. These are fixed proximally to the periostium of the inferior pubic rami to stabilize prosthesis (Figs. 18.10a, b). The reservoir is placed paravesically.

Some patients in our series chose to forego urethroplasty due to concerns related to potential complications. In some individuals, either a perineostomy was created or a neophallus was placed on top of a metoidioplasty; this approach minimized complications associated with a urethroplasty while allowing voiding from a standing position (Fig. 18.11).

Results

Follow-up ranged from 6 to 140 months (mean 78 months). A complete phalloplasty (all stages) was performed in 167 patients; additional 15 patients underwent also urethroplasty, 5 patients requested perineostomy, 8 patients requested metoidioplasty with phalloplasty, and an additional 21 patients are awaiting prosthesis placement. A urethral stricture developed in 32 patients. The majority of these occurred in the penile urethra, while five occurred at the junction of the proximal and penile urethra. Nine patients developed urethral diverticula at the pubic part, and five of these were treated surgically. Eight patients developed urethral fistula: two healed spontaneously, and six required surgical treatment. Penile prostheses were implanted in 172 patients; 117

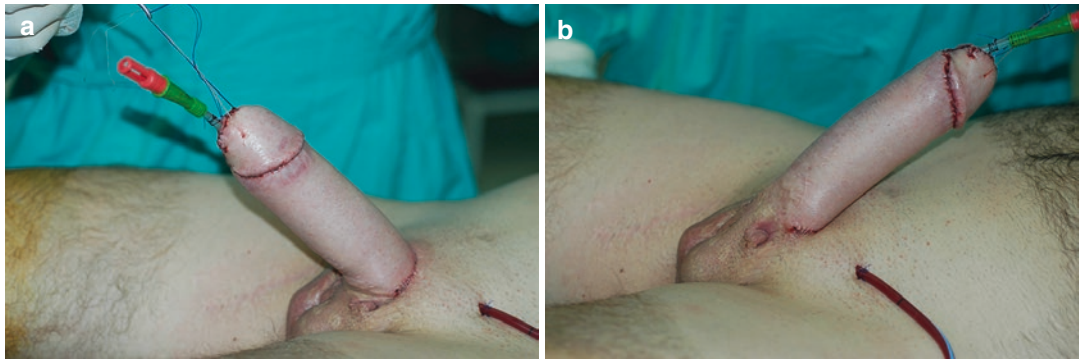

Fig. 18.10 (**a**, **b**) Implantation of penile prosthesis in the third stage

Fig. 18.11 Total phalloplasty with perineostomy

Fig. 18.12 Outcome 1 year after surgery

received inflatable, three-component; 12 received inflatable, two-component; and 43 received malleable (Fig. 18.12). Two cylinders were implanted in all patients. Nine patients did not request penile prostheses. Penile size varied from 12 to 26 cm in length and from 11 to 17 cm in circumference. Five partial and four total flap losses occurred. The donor site healed satisfactorily in 194 patients, while in the remaining patients mild to moderate scarring occurred. Fifty-nine patients required additional scar correction in the second or third stage. Infection requiring prosthetic removal occurred in 11 patients, prosthesis protrusion in 7 patients, malleable prosthesis fracture in 6 patients, inflatable prosthesis dysfunction in 4 patients, and misplacement requiring revision in 8 patients.

Discussion

Penile construction in transgender individuals presents a great challenge for the genital reconstructive surgeon. Initially, the primary indication for phalloplasty was limited to posttraumatic individuals who required surgery to retain or reconstruct their male anatomy. Today, indications have expanded to included transgender individuals, post-oncologic defects, and/or congenital deformities such as penile agenesis, micropenis, intersex conditions, or penile damage after epispadias or hypospadias repair [15, 17].

The penis is a unique organ characterized by the presence of a vascularized urinary conduit surrounded by erectile tissue, with the capacity to achieve erogenous sensibility; the complexity of the organ makes complete phallic reconstruction elusive at this moment. The ideal phalloplasty would result in the construction of an aesthetic phallus in a single surgical stage,

provide protective and erogenous sensibility, a volume large enough to place a prosthesis, sufficient rigidity to allow sexual intercourse, patency of the neourethra, and low donor-site morbidity. While many different surgical techniques are reported using both local tissue or microvascular tissue transfer [16], we believe that the musculocutaneous latissimus dorsi flap provides the most satisfactory outcome. The main advantage of this flap is the large surface area resulting in a penis of adequate size to permit both a urethroplasty as well as implantation of a penile prosthesis.

The musculocutaneous latissimus dorsi flap is easily elevated on a long and reliable vascular pedicle. This allows a direct anastomosis between the femoral artery and the flap without interposition of a vein graft. Removal of the latissimus muscle is associated with minimal donor site morbidity, which is rarely of functional significance [14]. This is especially true when only a thin muscle strip is harvested, as in our technique. Additionally, creation of the glans gives a satisfactory aesthetic appearance. Furthermore, neophallus retraction and discoloration are less likely than when a fasciocutaneous flap is used.

The donor site can be closed directly and satisfactorily in most patients if it is preoperatively prepared by superficial skin massage using skin emollients to improve elasticity. We also perform preoperative liposuction of the donor area in obese patients several weeks before flap harvesting in order to decrease flap thickness and allow easier, tension-free tubularization.

Implantation of the penile prosthesis is technically easier and better tolerated in a neophallus that contains muscle; the complication rates are significantly lower as compared to other flaps [18]. The disadvantage of the MLD flap is return of mild protective sensation of the neophallus which may result in a higher risk of prosthesis extrusion. However, we addressed this problem by wrapping the proximal and distal cylinders/rods with hernia mesh and proximal fixation to the pubic bones. The issue of sexual function in the neophallus remains problematic since the flap lacks orgasmic sensitivity; erogenous sensation is restricted to the clitoris, which is incorporated to the base of the neophallus. Psychological motivation as well as partner cooperation is mandatory for successful sexual intercourse.

Conclusions

The main goals of phalloplasty include functional reconstruction, patient satisfaction, and improved quality of life. Total phalloplasty using the musculocutaneous latissimus dorsi flap is a reliable technique that allows creation of neophallus of normal size with good aesthetic appearance and functional outcomes. The MLD flap allows urethroplasty and easy implantation of a penile prosthesis that provides successful sexual intercourse in a great majority of cases. Although the neurorrhaphy is made between sensory and motor nerves, slow development of protective sensibility is present in all patients. Erogenous sensitivity and orgasm are based on the clitoris, incorporated at the base of the penis.

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19 Radial Forearm (RF) and Anterolateral Thigh (ALT) Phalloplasty Reconstruction

Walter Lin and Bauback Safa

Introduction

Recent advances in societal acceptance and healthcare for transgender and gender-nonconforming individuals have highlighted gender-affirming genital surgery as a rapidly growing subspecialty. Despite the existence of a broad spectrum of gender identification, most procedures are generally categorized as feminizing or masculinizing procedures.

Regarding the genital system, masculinization requires a complex series of operations to alter primary and secondary sexual organs and characteristics, which in the fullest form may include hysterectomy, oophorectomy, urethral lengthening, scrotoplasty, and phalloplasty reconstruction.

One of the major conceptual challenges entails creation of a phallus de novo where no comparable structure previously existed on the body. This new structure has incredible demands from a reconstructive standpoint. Using available tissue from the body, the phalloplasty must recreate a complex three-dimensional structure to have a natural, aesthetic appearance (Fig. 19.1). The phalloplasty must integrate with the urinary system and constitute a water-tight, leak-proof conduit that can withstand repeated Valsalva pressure stresses and caustic exposure to urine, allowing standing micturition. The phalloplasty is also expected to be able to maintain sufficient rigidity to achieve sexual penetration. If an erectile implant is used, the phalloplasty must withstand significant repeated deforming and shearing forces that would otherwise threaten implant extrusion or exposure. Ideally the phallus would allow for neurotization to permit erogenous sensation. To add to this, the structure is expected to last for a lifetime, spanning decades.

Fig. 19.1 A flat, rectangular radial forearm fasciocutaneous flap is transformed into a complex three-dimensional, sensate organ with a functioning urethra and sexual function

Due to such high demands, masculinizing genital surgery with phalloplasty reconstruction requires coordination of multiple medical and surgical specialties. Typically, a team of plastic, gynecologic, and urologic surgeons are required. Reconstructive goals include the formation of an aesthetically pleasant phallus and scrotum, with

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tactile and/or erogenous sensation, that allows normal sexual function and standing micturition while minimizing donor site comorbidity.

Reconstructive Options

While searching for the ideal reconstruction to fulfil such demanding criteria, numerous designs have been attempted over the prior decades. Neophallus reconstruction was first reported by Bogoras in 1936 for reconstruction in a patient with penile amputation and used a pedicled abdominally based flap. A pedicled groin flap was used in 1972 by McGregor. The myocutaneous gracilis flap was described by Orticochea in 1972.

However, the advent of microsurgery allowed new possibilities using free tissue transfer. Options of historical interest include prelaminated free fibula flaps[1] and latissimus dorsi flaps [2]. However, the two most common designs that have withstood the test of time remain the tube-within-a-tube design utilizing the radial forearm free flap (RFFF) and pedicled anterolateral thigh (ALT) flaps, both of which accommodate erogenous neurotization.

The tube-within-a-tube design allows for simultaneous urethral and penile reconstruction with glans formation at the time of primary construction or in a delayed stage. The RFFF was first described in 1982 by Song et al. in China [3] and was shortly thereafter used for penile reconstruction in 1984 by Chang et al. [4] Over time, it has been found to be functional, safe, and reliable with the highest reported rates of survival among the most commonly performed free flaps [5]. Advantages include a reliable and predictable vascular pedicle, flap thickness conducive to double-tube formation, innervation density for favorable neurotization, and vascularity allowing glansplasty at the time of double tubing.

Anterolateral thigh phalloplasty provides an alternative in patients desiring a more concealed donor site, who have lower urinary demands, who are high-risk microvascular transplantation, or who prefer larger phallus size. Although ALT phalloplasty is typically done as a pedicled flap, microvascular techniques are still required for flap innervation. Occasionally, microvascular arterial and venous anastomoses are required due to inadequate pedicle length flap or the requirement for perforator-to-perforator supercharging to prevent partial flap loss due to the large flap size.

Indications/Criteria

Mental Health

Due to the irreversible nature and magnitude of surgery, the World Professional Association for Transgender Health (WPATH) Standards of Care guidelines recommend two formal referral letters from qualified mental health professionals. Mental health issues must be absent or well controlled. All recommended criteria are shown in Table 19.1.

The length of time required to live in a gender role congruent with the gender identity provides ample opportunity for patients to experience and socially adjust in their desired gender role before undergoing irreversible surgery.

Health professionals should clearly document a patient's experience in the gender role in the medical chart, including the start date of living full time for those who are preparing for genital surgery. In some situations, if needed, health pro-

Table 19.1 WPATH Standards of Care, version 7 criteria for genital surgery

Criteria for metoidioplasty or phalloplasty in transmen
1. Persistent, well-documented gender dysphoria.
2. Capacity to make a fully informed decision and to consent for treatment.
3. Age of majority in a given country.
4. If significant medical or mental health concerns are present, they must be well controlled.
5. 12 continuous months of hormone therapy as appropriate to the patient's gender goals (unless the patient has a medical contraindication or is otherwise unable or unwilling to take hormones)
6. 12 continuous months of living in a gender role that is congruent with their gender identity.
Although not an explicit criterion, it is recommended that these patients also have regular visits with a mental health or other medical professional

fessionals may request verification that this criterion has been fulfilled – they may communicate with individuals who have related to the patient in an identity-congruent gender role or request documentation of a legal name and/or gender marker change, if applicable.

Hormone Therapy

Typically, a minimum of 1 year of testosterone hormone treatment is recommended before genital surgery. Patients will notice dramatic increases in facial and body hair, muscle mass, male-pattern baldness, clitoral enlargement, and vocal deepening. The soft tissue response to hormone is essential if urethral lengthening is desired since the hypertrophied genital tissue allows for more robust reconstruction.

Formulations of testosterone are typically intramuscular or transdermal and must be prescribed by a qualified health professional due to potential adverse effects, including polycythemia vera, an abnormal lipid profile, and osteoporosis. Baseline labs and bone density scans are recommended.

Surgical Reconstruction of the *Pars Fixa*

Urethral lengthening entails reconstruction of the *pars fixa* urethra, which is the fixed segment of urethra that extends from the native urethral meatus to the clitoral head. The technique is the same for both radial forearm and ALT phalloplasty. Local tissue is recruited for tube formation, utilizing adjacent hairless labia minora tissue. Patients with inadequate tissue response to hormonal therapy may require recruitment of peri-vaginal introitus tissue based on the retrograde blood flow from the external pudendal blood supply [6]. For patients with deficient minora tissue distally, an epidermal autograft utilizing excess minora or vaginal epithelium may be used.

The first and arguably most important step of *pars fixa* urethral reconstruction is vaginectomy. The distal vaginal mucosa is often excised directly, or in some designs the anterior vaginal mucosa may be recruited as a local flap for urethral lengthening. Due to risk of bowel injury, it is preferable to ablate the proximal vagina using electrocautery. After removal of the vaginal mucosa, the remaining vaginal vault is sutured closed upon itself to eliminate dead space with great care taken to avoid deep sutures that could damage the underlying rectum. Careful tissue handling permits the use of bulbospongiosus muscle and fascial tissue for additional urethral suture line coverage.

Once the vaginectomy is complete, we proceed with urethral lengthening. In our experience, we find it essential to excise a triangular portion of mucosa surrounding the periurethral fornices (Figs. 19.2 and 19.3), which benefits twofold: this eliminates blind pouches within the

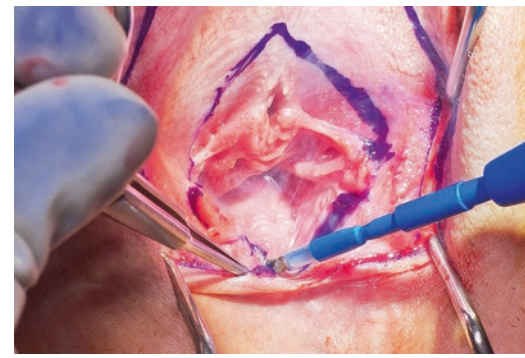

Fig. 19.2 Superiorly, the markings surrounding the periurethral fornices are shown. Inferiorly, the distal vaginal mucosa is circumferentially excised

Fig. 19.3 The periurethral fornices have been excised

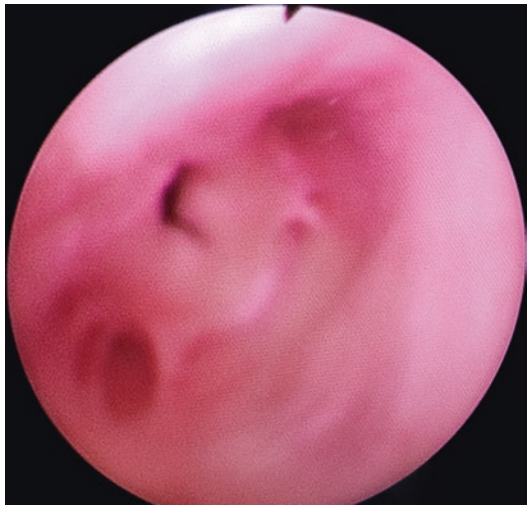

Fig. 19.4 Cystoscopy view of the native urethra with two surrounding periurethral fornices. Note the tendency for catheters to get caught in the blind pouch of the periurethral fornices, which makes access to the bladder difficult and potentially dangerous

Fig. 19.5 Labia minora flap markings for pars fixa formation

urethral lengthening, which potentially can complicate future Foley insertion (Fig. 19.4), and secondly this serves to decrease urinary stasis and debris accumulation.

Labia minora flaps (Fig. 19.5) are then elevated in a submucosal plane from distal to proximal (Fig. 19.6). If additional urethral lengthening is necessary, an additional 1–2 cm may be gained by utilizing the ventral clitoral epithelium in tubularization, via de-epithelizing the lateral edges of the clitoris (Fig. 19.7).

The *pars fixa* is then formed from the labia minora flaps being tubed around the native urethra. First, the medial labial flaps are closed in two layers to form the deep surface of the neourethra (Fig. 19.8). The lateral flap edges are then sewn together in layers, thus forming the superficial surface of the neourethra (Fig. 19.9a, b).

Fig. 19.6 The superiorly based labia minora flaps after elevation

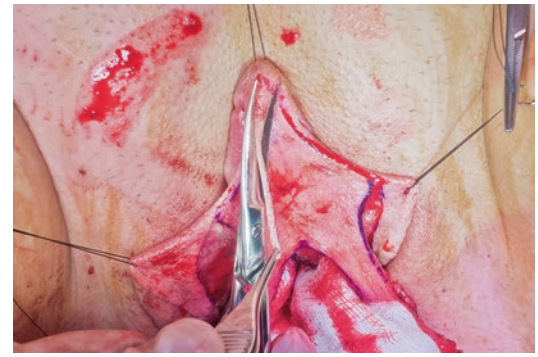

Fig. 19.7 If additional length is required, lateral strips of the clitoris are de-epithelialized, allowing the ventral surface to be included in pars fixa tubing as well

Fig. 19.8 The medial flap edges join to form the deep surface of the neourethra

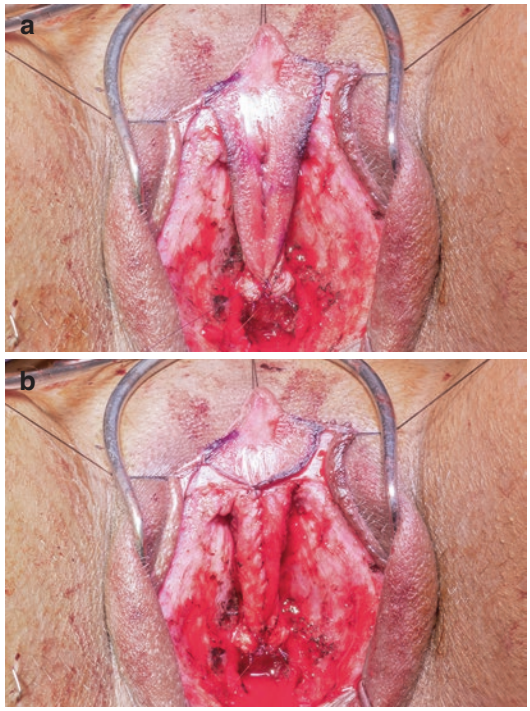

Fig. 19.9 The lateral edges of the labia minora flaps are sutured together from the native urethra (**a**) up to the clitoris (**b**) to form a tube

Fig. 19.10 Coverage of the most proximal pars fixa using labia minora dermal flaps. Here, dermal flaps are freed and elevated

Fig. 19.11 Right-sided labia minora dermal flap, anchored to the left and covering the urethral suture line

Fig. 19.12 The left-sided dermal flap is then reflected over the right-sided flap

Once urethral lengthening has been completed, we reinforce the *pars fixa* with local tissue flaps. The excess outer labia minora skin is trimmed, and the remaining labia minora dermal flaps then close over the origin of the *pars fixa* urethra in a "vest over pants" fashion, providing two additional layers of vascularized tissue overlying the takeoff of the urethral lengthening suture line (Figs. 19.10, 19.11, and 19.12). The mid and distal *pars fixa* are covered with bulbospongiosus musculofascial flaps (Fig. 19.13).

Thus, the proximal *pars fixa* is reinforced with vascularized soft tissue coverage via labia minora dermal flaps in addition to bulbospongiosus musculofascial flaps prior to skin closure of the perineum and scrotoplasty.

The clitoris is de-epithelialized and a dorsal clitoral nerve is identified and tagged for coaptation (Fig. 19.14). The midline position for the phallus is marked (Fig. 19.15), and the urethral lengthening segment and clitoris are transposed via a subcutaneous tunnel to the pubic mons in preparation for anastomosis (Fig. 19.16). Passage of a coudet catheter at this point verifies the fac-

Fig. 19.13 Coverage of the mid- and distal pars fixa using bulbospongiosus musculofascial flaps. They are sutured together, covering the urethral suture line of the mid and distal pars fixa urethroplasty

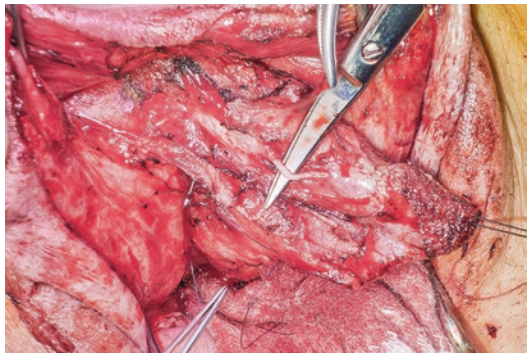

Fig. 19.14 The clitoris is reflected toward the patient's left, and the right dorsal clitoral nerve has been isolated

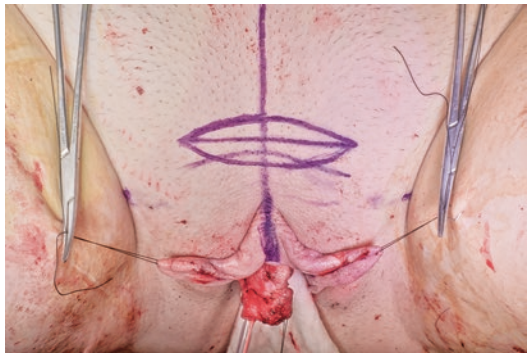

Fig. 19.15 A midline elliptical skin island overlying the pubis mons is excised at the anticipated location for phalloplasty placement

ile pathway through the urethral lengthening and is left in place in preparation for urethral anastomosis.

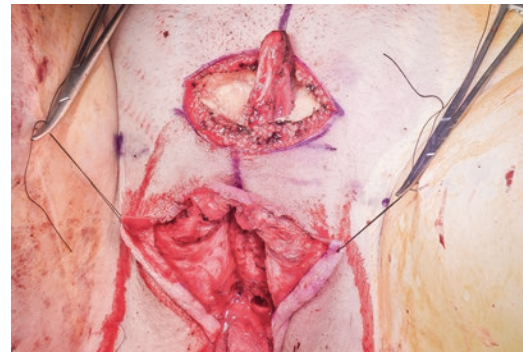

Fig. 19.16 Here, the lengthened urethra has been transposed. Note the excellent length gain, located above the level of the adjacent mons skin

Fig. 19.17 Markings for labia minora excision and labia majora flap elevation

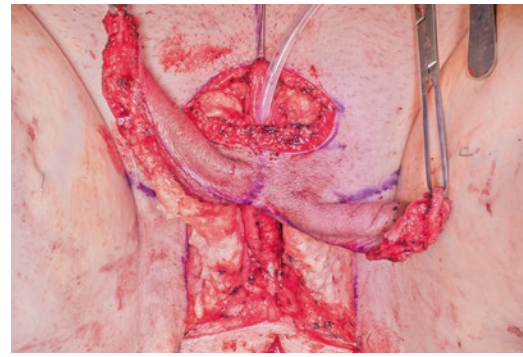

Fig. 19.18 Labia majora flaps are elevated for scrotoplasty

Labia majora fasciocutaneous flaps are then used for scrotal reconstruction (Fig. 19.17). The flaps are trimmed and sutured upon themselves in layers with absorbable sutures (Figs. 19.18, 19.19, and 19.20). At this point, the phalloplasty

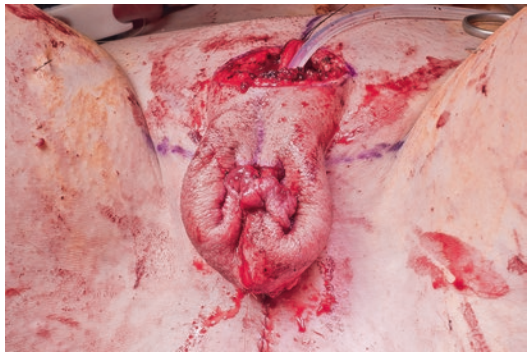

Fig. 19.19 Labia majora flaps are sutured for scrotoplasty. The perineum has been closed

Fig. 19.20 Excess labia majora tissue is excised for a more desirable scrotoplasty contour

flap is transposed to the pubic mons, and the required urethral anastomosis, nerve coaptation, and vascular anastomoses (if applicable) are completed. Scrotal implants are placed in a staged fashion after healing completes, typically at six months postoperatively minimum.

Surgical Reconstruction Using Radial Forearm Phalloplasty

The radial forearm phalloplasty is constructed by a second team simultaneously during *pars fixa* formation. For standing micturition, a double-tube design is used, allowing reconstruction of the *pars pendulans* — the distal portion of the reconstructed urethra within the phallus.

The radial forearm flap used in phalloplasty involves elevation similar to standard forearm flaps, utilizing the radial artery and venae comitantes and cephalic vein. However, attention to detail is given to preservation of an additional superficial vein to the urethral segment if available anatomically, as well as harvest of the lateral antebrachial cutaneous nerve (LABC) and other available sensory branches if favorable, with the exception of the dorsal radial sensory nerve (DRSN).

These design details and other considerations differentiate radial forearm phalloplasty from a typical radial forearm flap in planning for *pars pendulans* construction and an aesthetically pleasing appearance.

Preoperative Evaluation

The flap is typically harvested from the nondominant forearm. A standard Allen's test confirms the presence of an intact palmar arch. Although it may be tempting to investigate abnormal examination results with a formal interventional radiology angiogram, these studies do not demonstrate compensatory bloodflow with radial artery occlusion. Even with a diminutive or incomplete arch on angiogram, with proper patient counseling, it is reasonable to intraoperatively clamp the radial artery at the distal wrist; if the hand regains adequate perfusion despite radial artery clamping, then surgery may proceed with radial forearm harvest. Persistently abnormal perfusion may necessitate ALT phalloplasty harvest.

During flap design, attention is closely paid to the flap thickness as determined by pinch testing, as this determines whether double-tube reconstruction and glansplasty are feasible at the time of initial reconstruction. If the flap is deemed too thin – less than 0.5 cm with pinch testing – then glansplasty is not offered at the time of initial phalloplasty because of increased risk of inadequate blood supply to the distal glans after coronaplasty. Due to the full-thickness skin flaps required for coronaplasty, the subdermal plexus is no longer available to provide bloodflow to the distal glans.

There is no strict upper limit to flap thickness that precludes reconstruction in our experience. However, thickness quadruples with double tub-

ing (Fig. 19.21), requiring additional skin for increased flap circumference, thus creating a larger donor defect. Furthermore, increased flap bulk inherently creates more cumulative flap edema postoperatively, which threatens flap viability. The typical optimal pinch test thickness ranges from 0.75 cm to 1.5 cm.

During preoperative evaluation, note is also made of the level of hair-bearing skin. Hair removal, typically via laser or electrolysis, must be completed far ahead of surgery and decreases the risk of urethral stone formation and post void drip that occurs with the presence of large amounts of urethral hair. Fortunately, small amounts of hair are frequently asymptomatic.

Patients must be counseled regarding the impact of flap elevation on existing tattoos, which in many instances may be noticeable on the external phalloplasty. If desired, tattoo removal may be completed preoperatively or postoperatively on the phalloplasty after sufficient healing, prior to nerve regeneration and sensory return.

Surgical Markings

The double-tubed radial forearm phalloplasty flap is designed along the radial artery and just proximal to the wrist crease as shown in Fig. 19.22. Although it is tempting to harvest the most distal wrist tissue for maximum phallus length, note that placement of the flap too distally impairs wrist extension postoperatively and creates completely avoidable morbidity.

The radial and dorsal flaps serve as the external surface, while internalization of the ulnar portion forms the *pars pendulans* urethra. When determining the maximum length of the neophallus, consideration must be given to the length of flap pedicle required from the bifurcation of the brachial artery, which is estimated using the distance from the femoral vessels to the pubic mons.

In terms of flap width, the skin paddle must be wide enough to permit tensionless closure during tubing. There is no simple, specific formula used to calculate the width of the flap. Mathematically, the external flap skin should be $4\pi * \text{thickness}$. However, this calculation does not incorporate

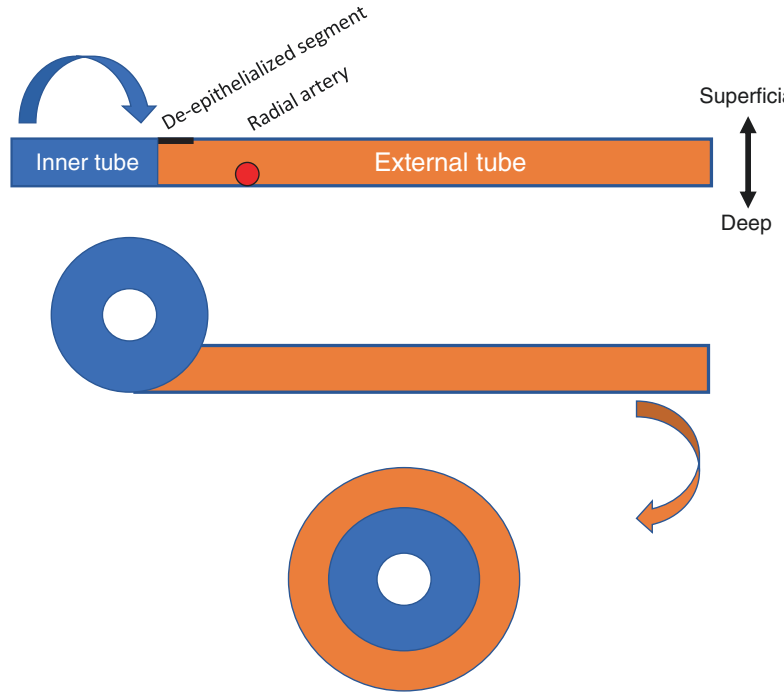

Fig. 19.21 The cross-sectional view of a radial forearm flap illustrating the thickness (diameter) of the double-tubed phalloplasty is equivalent to four times the flap thickness

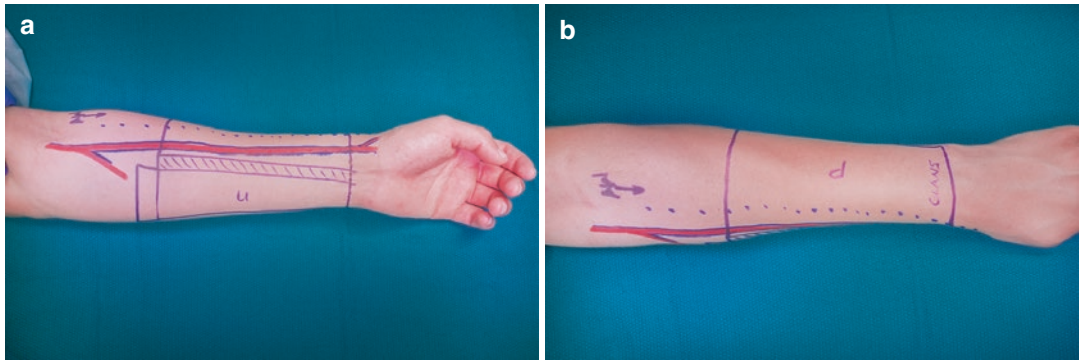

Fig. 19.22 The RFFF phalloplasty design is centered over the radial artery with the de-epithelialized segment placed ulnar to the FCR tendon (**a**, **b**)

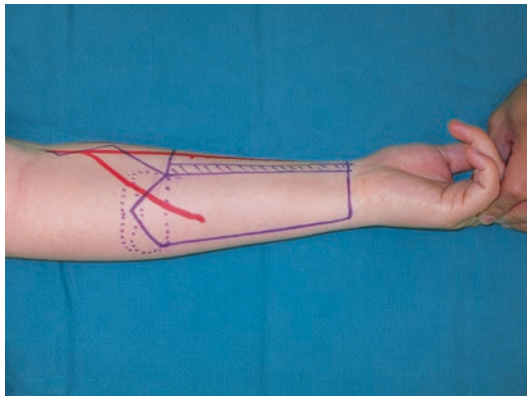

Fig. 19.23 Flap design showing "whale tail" (solid outline) versus "house" (dotted line) proximal urethral extension

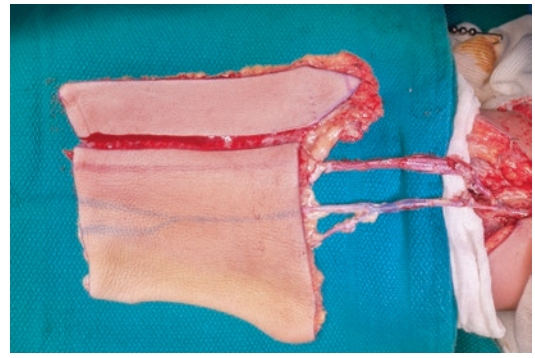

Fig. 19.24 "House" urethral extension with adipofascial flap

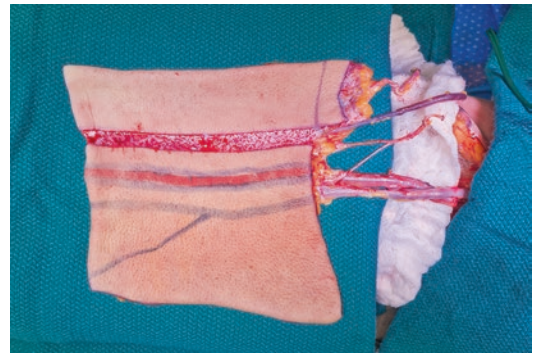

Fig. 19.25 "Whale tail" urethral extension with adipofascial flap. Note the preservation of an additional vein along the urethral segment as well as several nerve branches

unaccounted, unpredictable variables of varying skin elasticity, subcutaneous tissue compressibility, and postoperative edema. As a simple rule of thumb, if the remaining forearm skin is able to be pinched together, then a sufficient amount of skin will be harvested with the flap.

After determining the flap length and width, the remaining landmarks are determined. Just ulnar to the flexor carpi radialis tendon, a 1 cm strip is marked for de-epithelialization between the external and internal portions, which critically serves as the vascular bridge between the outer and inner tubes (Fig. 19.23). The proximal neourethra is designed either as a "house" or "tail" depending on the anticipated length gained with urethral lengthening, based on the soft tissue response to testosterone (Figs. 19.24 and 19.25). Both designs allow for obliquely oriented urethral anastomosis, but the "tail" design recruits more flap skin and is used when additional urethral length is required. However, the extent of

"tail" length is limited by flap perfusion, which is critical to preserve as this comprises the urethral anastomosis. The urethral strip is typically 4 cm in width distally and can be widened proximally. When tubed, this design allows for comfortable passage of a 16 Fr. Foley catheter.

Our group additionally harvests an adipofascial flap at the proximal urethral segment beyond the borders of the neourethra (Fig. 19.26). This provides vascularized soft tissue coverage circumferentially around the proximal neourethra and urethral anastomosis between the distal *pars fixa* and proximal *pars pendulans* urethra as discussed later in the chapter.

Proximally, zigzag incisions extend from the proximal flap markings to the antecubital crease for pedicle exposure.

Flap Harvest

The radial forearm flap is raised in typical fashion under tourniquet control with additional attention to several notable nuances.

The de-epithelialized skin strip is carefully harvested as thinly as possible in order to maximize preservation of the subdermal plexus for perfusion of the neourethra. The skin graft is spared for use with glansplasty later on.

The urethral adipofascial flap is elevated at the proximal edge of the urethral portion (Fig. 19.26). The forearm skin is elevated off of the flap in a subdermal plane for 1–2 cm beyond the border of the urethra. Later on, this provides vascular soft tissue coverage around the distal urethral lengthening and urethral anastomosis.

The cephalic vein is harvested and traced proximally until it joins with the deep venous system via the *profunda cubitalis* (deep cubital vein), thus combining the superficial venous drainage with the radial artery venae comitantes (Fig. 19.27).

If present, we spare the largest caliber superficial vein leading to the urethral segment (Figs. 19.25 and 19.26) and use this as a second venous anastomosis, ideally preventing venous congestion in the *pars pendulans* urethra.

The lateral antebrachial cutaneous nerve is harvested with the flap to provide sensation to the external neophallus. Smaller branches to the medial antebrachial cutaneous nerve may run along the ulnar flap and are optional but may be used as well. (Fig. 19.25).

The superficial branch of the radial nerve is preserved and left in situ in the forearm; however to avoid inadvertent thinning of the flap, the nerve is elevated with the flap and subsequently freed from the flap (Fig. 19.28).

Palmaris longus tendon is often harvested up with the flap if it is in proximity to the pedicle or venous plexus; otherwise it may be spared.

The radial artery and venae are traced proximally until the bifurcation of the brachial artery or until enough pedicle length has been elevated. In the rare instances where the radial artery pedicle is too short for midline positioning of the phallus, vein grafting may be required.

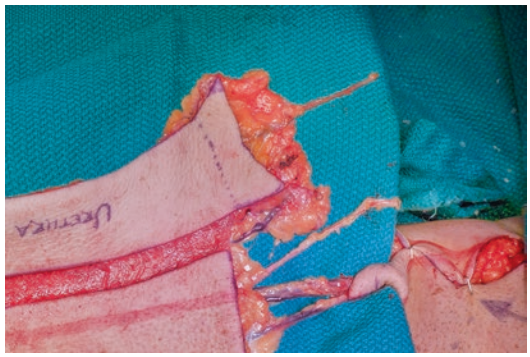

Fig. 19.26 "Whale tail" urethral extension with adipofascial flap. Note the preserved vein at the proximal urethral segment

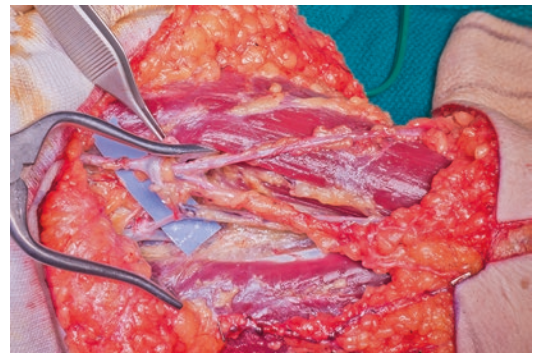

Fig. 19.27 Note the profunda cubitalis, joining the cephalic vein with the radial venae, thus combining the superficial and deep venous drainage systems

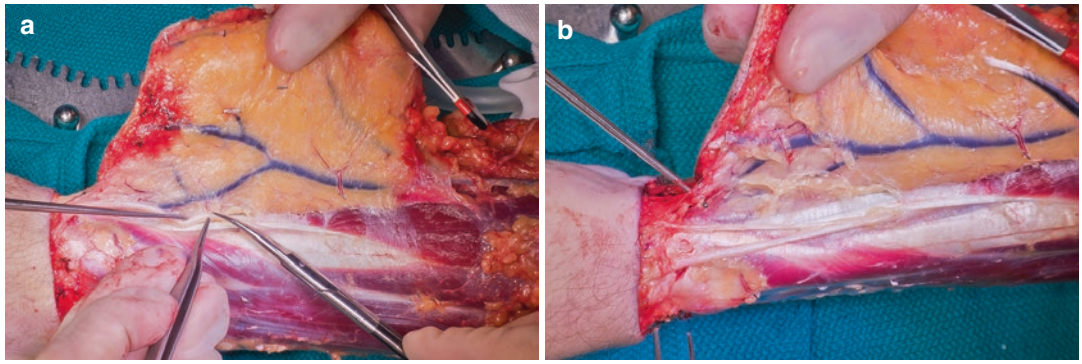

Fig. 19.28 Branches of the dorsal radial sensory nerve are initially elevated with the flap to prevent inadvertent flap thinning, and subsequently the nerves are (**a**) separated from the flap and (**b**) left in situ

Tubing

After tourniquet deflation, the flap is then double-tubed. The *pars pendulans* is tubed by joining the ulnar flap edge with the ulnar de-epithelialized strip edge, utilizing a two-layer closure with absorbable suture. Particular attention is given to shallow longitudinal bites along the dermal portion to prevent disruption of the subdermal plexus. A water leak test may be tempting, but too many additional sutures may secondarily compromise vascularity to the urethra.

The external flap is then wrapped around the *pars pendulans*. The radial flap edge is then sutured to the radial de-epithelialized strip edge in two layers with absorbable suture, again taking shallow bites through the de-epithelialized portion. The external epidermis is closed with a running absorbable suture. Thus the *pars pendulans* is enveloped completely with the vascularized forearm flap, with staggered suture lines that decrease the risk of urinary fistula.

Glansplasty

At the distal flap, the urethral tube and external tube are sutured together with interrupted monocryl. The coronal ridge is then marked using a 1 cm wide skin flap, based 3 cm from the glans tip, at a point on the dorsum opposite the external suture line (Fig. 19.29). Moving ventrally, the markings gently curve distally and taper together to join at the ventral raphe (Fig. 19.30).

Fig. 19.29 Coronal ridge markings. A 1 cm wide full-thickness skin flap is marked starting 3 cm from the dorsal glans tip

Fig. 19.30 Anterior curvature and tapered width of the coronal skin flap

The coronal ridge is then incised proximally and raised sharply as a full-thickness flap in a subdermal plane up to the distal marking (Figs. 19.31 and 19.32). Absorbable sutures are

Fig. 19.31 The coronal full-thickness skin flap is elevated in a subdermal plane

Fig. 19.32 Corona elevated, prior to suturing

Fig. 19.33 Coronal ridge after approximating the proximal and distal marking

then used to shape the coronal ridge circumferentially (Fig. 19.33). The skin graft is then placed over the denuded subcutaneous tissue proximal to the coronal ridge, taking care to not overly tighten the graft and constrict the glans (Fig. 19.34). At this point, the phalloplasty is left in situ until ready for flap division (Fig. 19.35).

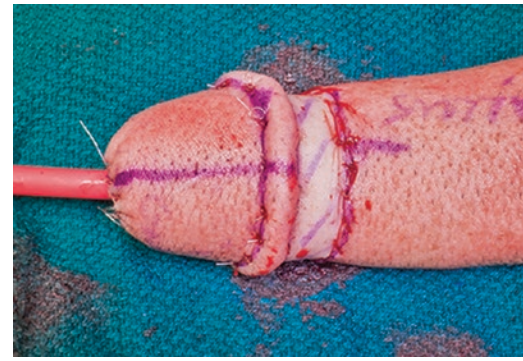

Fig. 19.34 Coronal ridge with skin graft (de-epithelialized strip) in place

Fig. 19.35 Phalloplasty with complete glansplasty prior to harvest from the forearm

Groin Preparation

The recipient vessels are prepared. The groin contralateral to the free flap is typically used, as this minimizes the required pedicle length to the recipient vessels. An incision is made from the femoral vessels toward the recipient site overlying the pubic symphysis and along the groin crease (Fig. 19.36). The superficial femoral artery is prepared for end-to-side anastomosis. The greater saphenous vein is prepared for end-to-end anastomosis (Figs. 19.37 and 19.38). If a urethral vein is available in the flap, additional smaller saphenous branches are prepared as well.

At this point, the patient undergoes *pars fixa* and *pars pendulans* anastomosis.

Forearm Donor Site Closure

The forearm is typically closed by the harvesting team during urethral anastomosis. In preparation for skin grafting, the large gap between the brachioradialis-flexor carpi radialis (BR-FCR) interval must be reapproximated, and the FCR tendon must be protected (Fig. 19.39). Absorbable suture is used to close the BR-FCR interval proximally and to cover the distal FCR tendon by imbricating the surrounding flexor digitorum superficialis (FDS) musculature (Fig. 19.40). A split thickness skin graft sheet from the thigh is piecrusted and inset over the forearm. The skin graft is bolstered using a negative pressure dressing, and a volar splint is fabricated. In thin patients, the skin graft contour blends well (Figs. 19.41 and 19.42) and may be camouflaged with tattooing after complete healing.

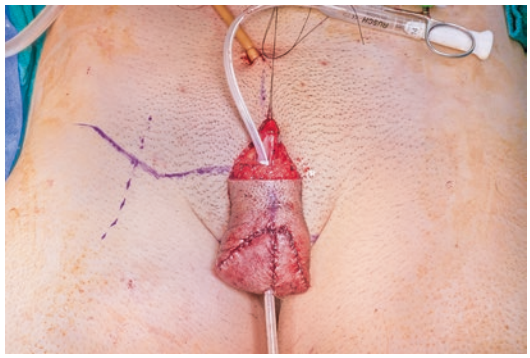

Fig. 19.36 Groin incision for exposure to the femoral artery (dotted line) and saphenous vein

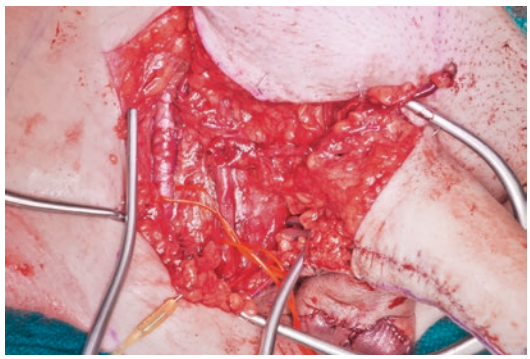

Fig. 19.37 Exposure of the SFA and saphenous vein. The phalloplasty has been partially inset

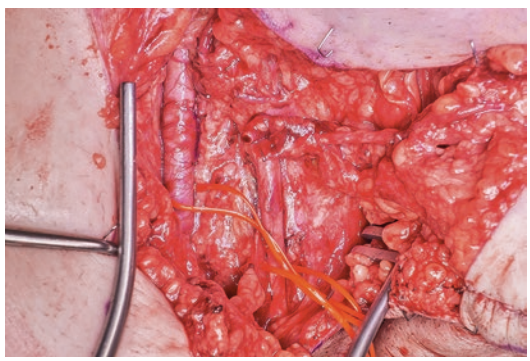

Fig. 19.38 Closeup of the SFA and GSV exposure

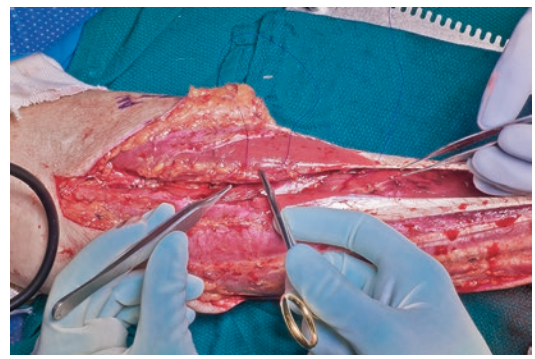

Fig. 19.39 The large gap in the BR-FCR interval and the exposed FCR tendon must be addressed before skin grafting of the forearm

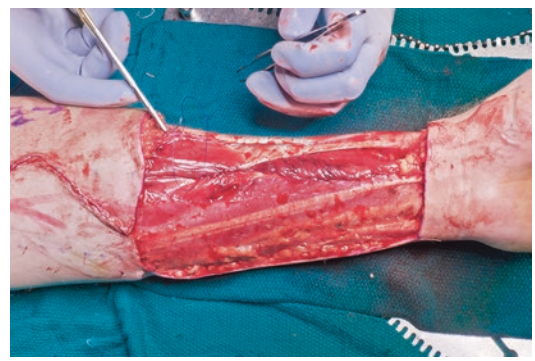

Fig. 19.40 Closure of the BR-FCR interval proximally and imbrication of muscle over the FCR tendon distally allows for a smooth vascularized bed that will readily accept a skin graft

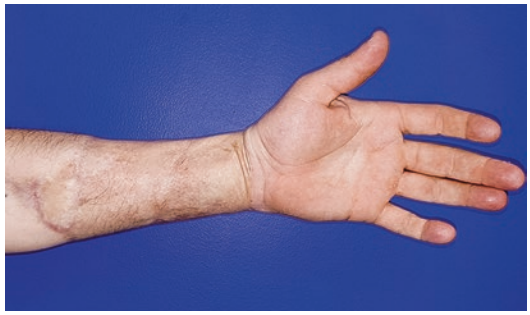

Fig. 19.41 Forearm donor site, volar

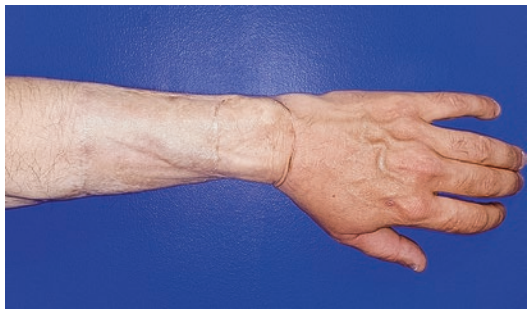

Fig. 19.42 Forearm donor site, dorsal

Pars Fixa and Pendulans Anastomosis: RFFF

A guidewire is passed through the *pars fixa* catheter. The RFFF phallus with *pars pendulans* urethra is then harvested from the forearm. A new Foley is then passed retrograde through the phalloplasty *pars pendulans* and then passed through the *pars fixa* into the bladder over the guidewire.

A watertight urethral anastomosis is then meticulously completed using slowly absorbable monofilament suture. The adipofascial flap along the proximal RFFF is then used to cover the urethral anastomosis and distal *pars fixa*, and anchored to the surrounding tissue using monocryl (Figs. 19.43 and 19.44). The sensory nerve coaptation is performed between the dorsal clitoral nerve branch and flap nerves.

At this point, the microvascular anastomoses are performed consisting of an end-to-side anastomosis to the superficial femoral artery and end-to-end anastomosis between the conjoined flap vein and greater saphenous vein and, if available, an end-to-end anastomosis between the additional urethral vein and a tributary to the saphenous vein. Implantable venous Dopplers are routinely used in conjunction with external Doppler monitoring.

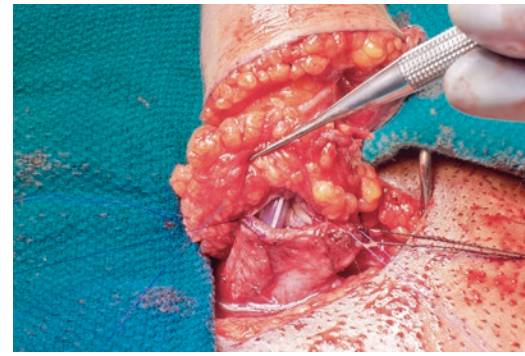

Fig. 19.43 Adipofascial coverage of urethral anastomosis with pars fixa and pars pendulans. The Foley catheter is visualized in the neourethra

Fig. 19.44 Adipofascial coverage of urethral anastomosis

The phalloplasty is inset with deep dermal and running monocryl sutures, taking care that the base is not constricted during closure (Fig. 19.45). After completion, the phalloplasty is elevated away from the side of vascular anastomosis to prevent pedicle kinking (Fig. 19.46).

Patients are routinely placed on bedrest until postoperative day 4 and discharged home on postoperative day 5.

Fig. 19.45 Phalloplasty immediately postoperatively after completion

Fig. 19.46 The phallus is elevated using a specialty hammock, away from the vascular anastomosis to prevent vascular kinking

Surgical Reconstruction Using Pedicled Anterolateral Thigh (ALT) Phalloplasty

The *pars pendulans* using the anterolateral thigh (ALT) flap is harvested by a second team simultaneously with *pars fixa* formation. The ALT phalloplasty is elevated in similar fashion to standard ALT flaps with particular attention to specific considerations as detailed below.

Preoperative Evaluation

Pinch testing of the thigh is performed preoperatively to estimate flap thickness. To preserve sensory capacity, the flap must be harvested in a standard fashion with the underlying fascia to capture arborizing branches of the lateral femoral cutaneous nerve, which runs along the deep fascia. Pinch testing estimates flap thickness, but unfortunately this is typically too thick for double-tube formation, and consequently the phalloplasty must be made as a single tube. A thinned out suprafascial ALT is an option but would lack neurotization due to nerve anatomy as described.

If thickness precludes double-tube formation at the time of primary phalloplasty, the patient must decide whether to forego urethral lengthening and live with a single-tube phalloplasty or proceed with staged urethral reconstruction (described in the revision section below) for inner tube formation in a delayed fashion.

If thigh donor site scars are unacceptable to the patient, consideration can be given to thigh tissue expander placement medial and lateral to the anticipated flap location. At the time of flap harvest, the expanded skin may allow primary closure of the thigh, thus avoiding or minimizing the use of skin grafting.

Surgical Markings

The legs are typically positioned in stirrups for *pars fixa* formation, and due to positioning constraints, the flap is typically harvested from the right thigh for a right-handed surgeon. Perforators are identified using standard landmarks and an external Doppler probe. The flap is centered over the perforators regardless of whether a single or double tube template is used. The design is shifted distally to maximize pedicle length (Figs. 19.47 and 19.48) to allow for midline inset of the phallus. This may require de-epithelializing the most proximal extent of the flap to allow more distal skin paddle placement.

If double tubing, the urethral segment is placed on the medial thigh in order for the longitudinal phalloplasty suture line to lay ventrally.

Flap Harvest

The ALT flap is harvested in standard fashion from medial to lateral in a suprafascial plane until the

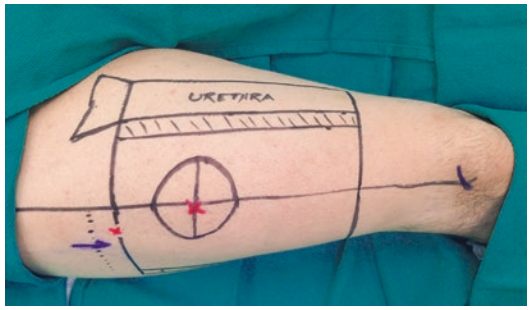

Fig. 19.47 ALT phalloplasty flap markings

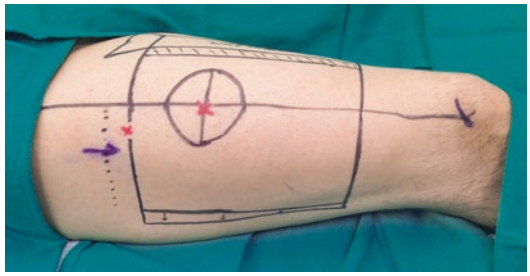

Fig. 19.48 ALT phalloplasty flap markings. The flap is centered over the identified perforators

lateral border of the rectus femoris is encountered, at which point a subfascial plane will allow identification of perforators and capture of the lateral cutaneous femoral nerve (LCFN) and arborizing cutaneous branches. The LCFN is identified and dissected proximally in preparation for coaptation to the clitoral nerves. The remainder of the flap is elevated from lateral to medial and intramuscular perforator dissection is completed.

Aggressive defatting should not be performed during this first stage, as branches from the lateral femoral cutaneous nerves run from the fascia to the skin.

If inadequate perfusion is evident, the flap may be supercharged based on additional perforators. In Figs. 19.49 and 19.50, a large medial perforator from the superficial femoral system was dissected and anastomosed to the distal descending branch of the lateral circumflex femoral artery (closeup in Fig. 19.51). The remainder of the flap was perfused by the transverse branch of the LCFA.

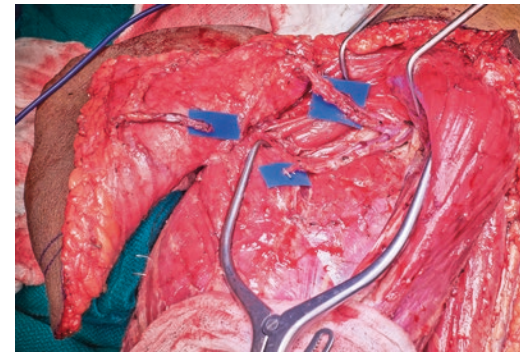

Fig. 19.49 A medial perforator is prepared for anastomosis to the distal descending branch of the lateral circumflex femoral artery and venae

Fig. 19.50 The flap is well perfused after supercharging of the perforator and venae comitans to the distal descending LCFA

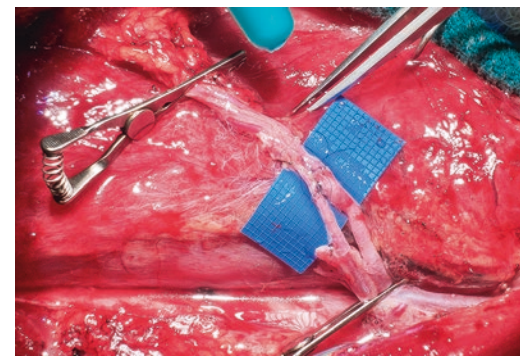

Fig. 19.51 Closeup of the anastomosis between the medial perforator and descending LCFA

Tubing

The flap is either formed as a single tube or double tube in the same fashion as a radial forearm flap using absorbable suture. The pleating at the urethral opening smooths over time.

Glansplasty

Glansplasty is not performed at the time of primary phalloplasty formation, since the distal blood supply would be inadequate after disruption of the subdermal plexus for corona formation. Glansplasty may be performed safely two to three months postoperatively or later.

Groin Preparation and Flap Transfer

A submuscular tunnel is created deep to the rectus femoris and sartorius muscles. A subcutaneous tunnel is then made to join the incision over the pubis. The flap is then delivered carefully through the submuscular and subcutaneous tunnels into the pubis.

At this point the operating microscope is brought into the field for coaptation of the lateral femoral cutaneous nerve branches to the clitoral nerve.

If pedicle length is inadequate for midline phallus placement despite complete pedicle dissection proximally, then conversion to a free flap using vein grafting is recommended.

Donor Site Closure

The rectus femoris and vastus lateralis are reapproximated using an absorbable quill suture. The skin flaps are advanced to reduce the wound size, using similar absorbable quill sutures. A skin graft is then harvested, meshed, and inset. The skin graft is bolstered using negative pressure therapy and compressive wraps.

Urethral Anastomosis and Closure: ALT

The ALT phallus with *pars pendulans* urethra is passed under the submuscular and subcutaneous tunnel into the pubis. If a double-tube design is used, a guidewire is passed through the existing *pars fixa* catheter, allowing exchange for the *pars pendulans* catheter. A watertight urethral anastomosis is then meticulously completed using slowly absorbable monofilament suture.

Regardless of a single or double-tube design, the sensory nerve coaptation is performed between a dorsal clitoral nerve branch and the lateral cutaneous femoral nerve branches.

The phalloplasty is inset with deep dermal and running monocryl sutures, taking care to avoid base constriction during closure. After completion, the phalloplasty is elevated toward the left thigh to prevent kinking of the underlying pedicle.

Postoperative Management

Hospitalization

Postoperatively, patients are maintained on bedrest for 3 days, and activity is gradually advanced on days 4 and 5. Care must be taken to prevent fluid overload, which risks flap edema and vascular compromise. The forearm or thigh negative pressure wound vacuum devices are removed on the fifth day. For RFFF donor sites, a splint is applied for another two weeks and referral is made to a hand therapist for a range of motion and strength exercises. The patient is discharged home with the urethral catheter and suprapubic tubes.

The urethral catheter is removed after 1 to 2 weeks, and the following week the patient is instructed to void, roughly 3 weeks postoperatively. If voiding is uncomplicated then the suprapubic catheter is removed one week later.

Postoperative Revision

Postoperatively, patients may occasionally seek nonurologic revision. The most common types of surgery are listed in Table 19.2. Revisions that are urologic in nature, such as urethral strictures or fistulae, are beyond the scope of this chapter.

Glansplasty and Coronaplasty

In some instances, glans formation cannot be performed at the time of initial phalloplasty (Fig. 19.52a), typically because of the resulting inadequate distal blood supply after disruption of the subdermal plexus required for corona formation. Glansplasty is best performed after postoperative edema resolves and tissue regains suppleness, typically in 2–3 months.

The glans is shaped as described in the radial forearm phalloplasty section using a full-thickness, distally based flap that is imbricated upon itself to recreate the coronal ridge. The full thickness skin graft is typically harvested from the groin and is combined with groin scar revision (Fig. 19.52b).

Even with glansplasty during primary phalloplasty formation, the coronal ridge may flatten and lose prominence over time. Coronaplasty revision may be safely performed with re-elevation of the coronal skin flap and full thickness skin grafting the resulting defect.

Table 19.2 *Revision surgeries following phalloplasty*

Revision surgeries following phalloplasty	
Non-urologic	Urologic
Phallopexy Glansplasty Coronaplasty Urethral tube Erectile implant Debulking Forearm fat grafting Phalloplasty fat grafting Thigh skin graft excision Tattooing	Fistula takedown Stricture takedown

Debulking

Some patients who have had ALT phalloplasty construction may desire debulking procedures. In general, direct fat excision is preferred over suction lipectomy because of lower risk of injury to the underlying urethral tube and cutaneous branches of the lateral femoral cutaneous nerve.

Urethral Tube Formation

In single-tube ALT phalluses, staged urethral reconstruction requires soft, supple flap tissue with enough skin laxity to allow imbrication. After initial surgery, patients undergo flap debulking as an intermediate stage. After reaching soft tissue equilibrium, the second stage is performed wherein the flap is imbricated upon itself to form an inner urethral tube. A subsequent stage is then required for pars fixa and pars pendulans urethral anastomosis.

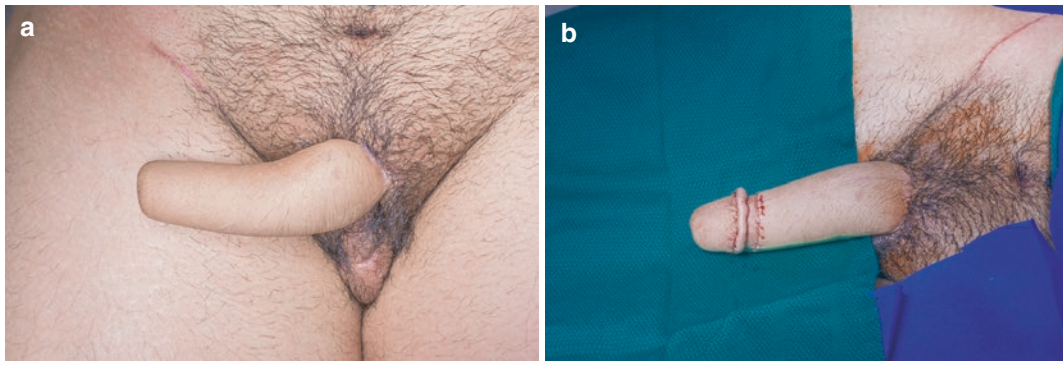

Fig. 19.52 Phalloplasty before (**a**) and after (**b**) delayed glansplasty. Note the full-thickness skin graft donor site incision in the right groin

Phallopexy

Due to the pendulous nature of phalloplasty, the scar at the phalloplasty base may widen over time, causing displacement of the phallus inferiorly. Correction entails "phallopexy" re-suspension with scar revision and a crescentic excision superiorly as shown in Fig. 19.53 a–c.

Erectile Implant Placement

Several implant types are available, but the most common are semirigid rods and inflatable implants. Regardless of the type used, most groups wait until at least 6 months postoperatively due to the prerequisite development of sensation in the phallus. In general, the implants are anchored to the pubic symphysis proximally, creating support with penetrative intercourse and preventing subluxation.

Fat Grafting

Fat grafting may be indicated in some instances to correct forearm donor site contour abnormalities as well as treat hypersensitivity along the dorsal radial sensory nerve attributable to thin soft tissue coverage with only a skin graft. Both are correctable with serial fat grafting in a plane directly below the skin graft.

In a similar fashion, fat grafting may be desired to augment the bulk of the phalloplasty reconstruction. Due to the limited vascularity of the neophallus, care still needs to be taken to avoid the vascular pedicle even when performed in a delayed fashion.

Other Forearm and Thigh Donor Site Revisions

Skin graft along the forearm and thigh donor sites may be excised to improve thigh contour and eliminate laxity as in Figs. 19.55 and 19.55. This can be combined with fat grafting to improve the contour and tissue quality even further.

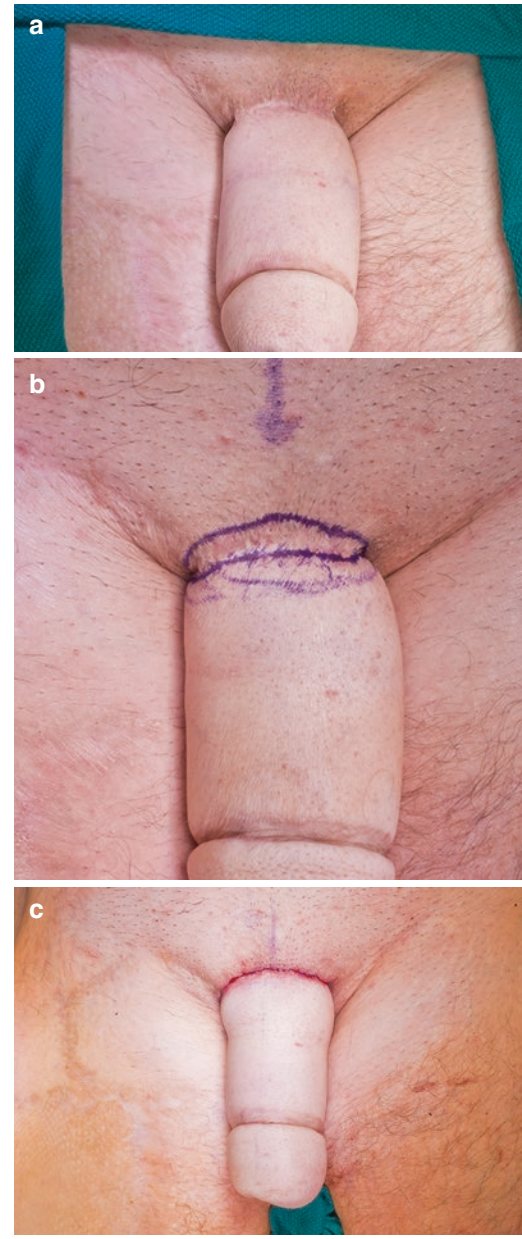

Fig. 19.53 Crescent phallopexy for scar widening. (**a**) Widened scar. (**b**) Crescentic excision marked. (**c**) Immediate postoperative appearance

Tattooing

In general, tattooing of the forearm donor site is safe after complete healing and reaching soft tissue equilibrium, generally six months postoperatively. Care should be taken to avoid the radial

Fig. 19.54 Preoperative appearance of thigh skin graft donor site

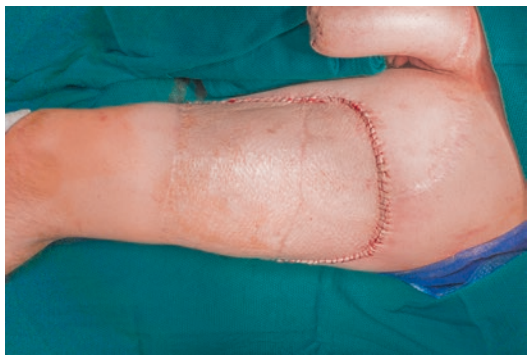

Fig. 19.55 Postoperative appearance after skin graft excision and contour revision

sensory nerve branches or areas that may cause delayed wound healing.

Potential Complications

Aside from typical risks of microvascular tissue transplantation, phalloplasty reconstruction additionally has complications related to urethral fistulas, strictures, and long-term urologic complications which are beyond the scope of this chapter.

However, specific care must be taken to prevent excessive postoperative edema within the phalloplasty, as this can result in a compartment-syndrome-like phenomenon that can result in flap loss if left unchecked. Due to the fixed circumference at the base of the phalloplasty, flap edema may compromise venous outflow. If suspected, the ventral suture line should be released to allow decompression. Diuretics may be required as well. Failure to improve mandates operative exploration for release of the phalloplasty base and possible pedicle exploration.

After decompression, the flap should be left unfurled and dressed with local wound care and given time to equilibrate. A skin graft to the ventral surface provides temporizing wound coverage allowing discharge from the hospital. After achieving supple tissue quality, the skin graft is excised at a later surgery, typically in several months' time.

Conclusion

Gender-confirming surgery comprises a rapidly growing subspecialty where demand exceeds the availability of qualified surgical specialists. With proper attention to the subtleties underlying patient selection, flap design, flap harvest, urethral reconstruction, and postoperative care, radial-forearm and anterolateral-thigh phalloplasties both provide safe, aesthetic, and functional genital masculinization.

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21

Strategies to Optimize Sexual Function with Feminizing and Masculinizing Genital Gender-Affirming Surgery

Maurice Marcel Garcia

Introduction

Many patients who identify as transgender and gender non-binary describe being unable to engage in a fulfilling sexual life *before* genital gender-affirming surgery. Negative feelings they may have toward their own genitals may make it difficult (for some, *impossible*) to find any pleasure in activity related to their genitals [1–4]. A subset of patients may describe unambiguously *negative* feelings toward this part of their bodies, and many report that their genitals are the most, or among the most, significant source of gender dysphoria [5]. Such feelings can preclude the ability to engage in self-pleasuring (masturbation) and/or the ability to have sexual relationships with others. Many patients describe orgasm before genital gender-affirming surgery as conflicted—offering fulfillment of physical needs but at the same time aggravating often intense gender dysphoria. [4, 5] Sexual activity, alone or with a partner, can be a reminder that an important part of their body is not as it should be and does not reflect the individual's sense of self.

In this context, for many patients gender-affirming genital surgery affords the *first opportunity* ever to experience self-pleasure or sex with someone else with their body more closely aligned with who they are [2, 5]. For many people, one of the *most important* aspects of genital surgery is that it not only makes it *possible* to have sex (i.e., provides the correct genital anatomy), but for many it also affords a sense of confidence that, when they are ready to, they are *able* to have and enjoy sex.

Predicting Sexual Function After Genital GAS

Experience teaches that a strong predictor of poor sexual function *after* genital surgery is poor sexual function *before* surgery [1, 2, 6].

It is important to identify patients whose long history of gender dysphoria has resulted in minimal to no experience with orgasm either alone or with a partner, as it is these patients who may benefit most from guidance regarding the erogenous landscape/functions of their new genital anatomy.

Pre-surgery Domains that Affect Sexual Health

Medical History

Common medical conditions that affect the sexual function of all people include *diabetes types I*

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and II, which can result in peripheral neuropathy and decrease genital sensation. *Obesity* can make it difficult for patients to access and stimulate their genital areas and is independently associated with both type II diabetes and depression resulting from a negative body self-image. *Low libido* can be caused by a number of medical and mental health conditions, as well as medications, including cross sex hormones (anti-androgens, estrogens) and depression and anxiety medications. Similarly, medical conditions or drugs that affect the pituitary axis or neuromotor functions (multiple sclerosis, Parkinson's disease, chronic alcoholism) can disturb libido and sexual function [7].

Mental Health: Depression and anxiety are independently associated with decreased libido and/or anorgasmia [7].

Medications and Drugs: Medications for anxiety and depression (e.g., elective serotonin reuptake inhibitors (SSRIs)) can cause delay in orgasm and/or anorgasmia, in addition to decrease in libido. Indeed, SSRIs are a common treatment for premature ejaculation in cis-gender men. Chronic marijuana use affects the pituitary axis and can lower libido, and substance abuse can have similar effects [6–9].

Social Factors: The lack of a sexual, or even romantic, partner can be a natural barrier to sexual experience and activity. Gender transition, before and especially after surgery, can strain existing romantic relationships and lead to termination of relationships.

Unrealistic Expectations: Management of patient's expectations is a key factor in the practice of good medicine. Unrealistic expectations are a near certain barrier to satisfaction with treatment-related outcomes. Some patients can defer exploring their sexuality and gaining experience with sexual activity until they undergo genital surgery based on the hope that new anatomy will somehow by itself help in these domains. Development of a positive self-image and interpersonal relationships that can include sexual activity are important domains that should be discussed and, when necessary, addressed with the aid of a therapist/mental health provider [2, 6, 9].

How Being Sexually *Functional* Can Impact Quality of Life

It is useful to consider how important being "sexually functional" (simply being *able* to be sexual when desired) is for quality of life, by considering the adverse effect on quality of life that *not* being sexually functional has for patients. Before gender-affirming surgery, some patients find it difficult to enter into intimate relationships because doing so increases the likelihood that the relationship may turn sexual, a prospect that for many severely aggravates their gender dysphoria. In contrast, genital gender-affirming surgery affords patients the reassurance that being sexual, with anatomy that does not aggravate feelings of gender dysphoria, is an *option* for them if and when they choose. For many, the option to function sexually can have a profound effect on quality of life, regardless of how sexually active they choose to be.

Cedars-Sinai Pre- and Post-genital Gender-Affirming Surgery Sexual Function Rehabilitation Protocol

We have developed an organized approach for helping patients achieve satisfactory sexual function after genital GAS [6, 8–10].Our approach bridges the pre- and post-operative therapeutic windows.

Before Surgery

1. *Explain the challenges to sexual function after surgery that may arise*: For patients that have experience with erogenous sensation and orgasm, we explain that the location on their bodies for where they experience erogenous sensation may *change* (e.g., penectomy coupled with creation of a neoclitoris with feminizing surgery; transposition of the native clitoris into the phallus with masculinizing surgery) and that patients will have to search for the erogenous zones on their body *after* surgery.

2. *Reassure the patient that they should expect to be able to experience orgasm after surgery.* Many patients harbor the fear that with the "major surgery" they will undergo (genital GAS), they will lose their ability to achieve satisfactory orgasm. With anatomy-focused surgical techniques, erogenous sensation can be preserved and maximized. Reassurance about this helps to lower anxiety and fear which can preclude achieving satisfactory sexual function post-surgery.
3. *Confirm familiarity with their own erogenous anatomy and orgasm function before surgery*: We confirm that the patient is capable of and has experience with achieving orgasm before they undergo surgery because any pre-existing lack of knowledge of the sexual function of their body will likely make it more challenging to begin to learn *after surgery.* Many patients, however, have significant dysphoria about their genitals before gender-affirming surgery and are disinclined to explore their bodies and/or be sexual until they have undergone gender-affirming surgery. These feelings must certainly be respected, but, we have found it constructive to begin this important discussion by *explaining* the rationale for familiarizing themselves with their erogenous anatomy and orgasm function before and after surgery. Many patients find it easier to do so when this task is presented as a non-sexual, "pre-surgery" preparatory activity or a form of "prehab." Furthermore, encouraging patients to explore their own anatomy *without* a partner makes the activity less dysphoria-inducing.

Early After Surgery

1. *Self-stimulation-guided sensory mapping*: Beginning within days after surgery, we encourage gentle touch sensory stimulation of the new genital areas to confirm the location and extent of *tactile* and *erogenous* sensation. Patients often find it reassuring to confirm that their sensation is intact.
2. *Self-stimulation-augmented neuroplasticity*: We encourage patients to progress to more diverse self-stimulation (e.g., using diverse stimuli types and patterns), in order to drive a regular flow of sensory stimuli *to* their peripheral anatomy and in turn to the *brain*. We hypothesize that doing so drives changes within the brain to better recognize their new genital anatomy, and to define sensory input arising in a sexual context, as *erogenous.*

Neuroplasticity refers to the brain's ability to form new neural connections and to reorganize itself throughout life. For example, the concept that the different areas of the brain altogether form a "homunculus" or a body-shaped map of a person where each area of the person's body maps to a discrete region of the brain. With vaginoplasty or phalloplasty surgery, for example, the size, shape, and location of the genital area *change* [10].

Furthermore, not only does the three-dimensional nature of the genital tissues change, but the three-dimensional *representation* of their *genitals*, *at the level of their brain cortex*, also changes. After surgery, changes to the body on the outside require that the sensory-motor homunculus inside the brain cortex must also change [2, 10].

The flow of stimuli from the peripheral to the central nervous system can occur across a variety of sensory nerves, utilizing various receptors. For example, light-touch and firm-touch stimuli, and temperature, vibration, and pain stimuli, are carried to the brain via different receptors and, in many cases, different nerve pathways. For these reasons, we recommend that with post-surgery self-stimulation for the purposes of sensory *rehabilitation* (versus for *sexual* purposes), patients consider incorporating use of a variety of aids that may be useful to generate diverse stimuli, such as use of a vibrator (with controllable frequency and intensity), warming gels, and lubricants. We also suggest that, until patients feel comfortable with their function, and not self-conscious, that they do the above alone, as this eliminates partner-related performance anxiety as well.

We hypothesize that with more flow of diverse stimuli to the brain, the brain reorganizes to accommodate greater and more detailed sensory input from patients' new anatomy [9, 10].

Sexual Function After Feminizing Genital GAS

Surgical Considerations to Maximize Genital-Erogenous Sensation

Preservation of the Ilioinguinal Nerve and Genital Branch of the Genitofemoral Nerve

Bilateral orchiectomy is performed as a stand-alone procedure either before vaginoplasty or during vaginoplasty.

The ilioinguinal nerve, which provides sensation to skin at the root of the penis, anterior scrotum, and mons pubis area in male anatomy, lies superficial to *cremasteric fascia* of the spermatic cord (Fig. 21.1).

The genital branch of the genitofemoral nerve, which provides sensation to the inner thigh and anterior scrotal skin in male anatomy, lies superficial to the *internal spermatic fascia* [7, 11] (Fig. 21.2).

As the spermatic cords are dissected, these two nerves can be preserved by sweeping the external spermatic fascia and cremasteric fascia off of the internal spermatic fascia distal to proximal along the spermatic cord. This allows the proximal spermatic cord tissues, within which these two nerves run, to be reflected off of the cord before the cord is clamped proximally and ligated (Fig. 21.3).

Construction of the Neoclitoris

The neoclitoris is constructed using tissue from the proximal glans penis (Fig. 21.4a) [2], which, similar to the clitoris of a cis-gender woman, has numerous nerve endings that, at the level of the brain, map to the erogenous sensory center(s) within the cortex [10]. The dorsal nerves of the penis contain afferent nerves that carry nerve stimuli from the glans penis to the brain [7, 11].

Maximal Preservation of the Neurovascular Bundle

The dorsal nerves reside within *Buck's fascia* on the dorsum of the penis shaft, together with the penis' dorsal arteries and dorsal vein. This packet of nerves and vessels is called the *neurovascular bundle* (NVB) of the penis (Fig. 21.4b) [10]. In order to *maximally* preserve as many branches of the NVB as possible, we elevate the NVB off of the tunica. We begin by incising Buck's fascia as ventral-laterally as possible, on the ventral shaft at the junction of urethra and the corporal body

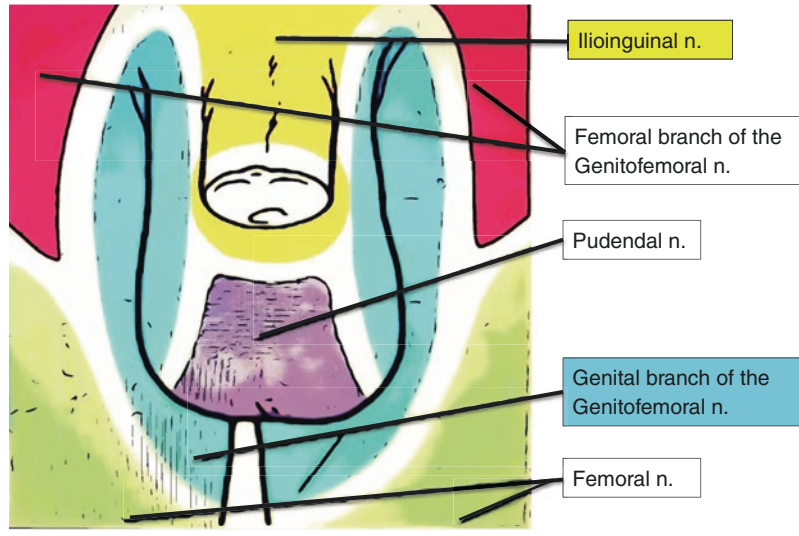

Fig. 21.1 Sensory nerve dermatome, highlighting the sensory distribution of the ilioinguinal nerve (yellow) and the genital branch of the genitofemoral nerve (blue) in natal male genital anatomy

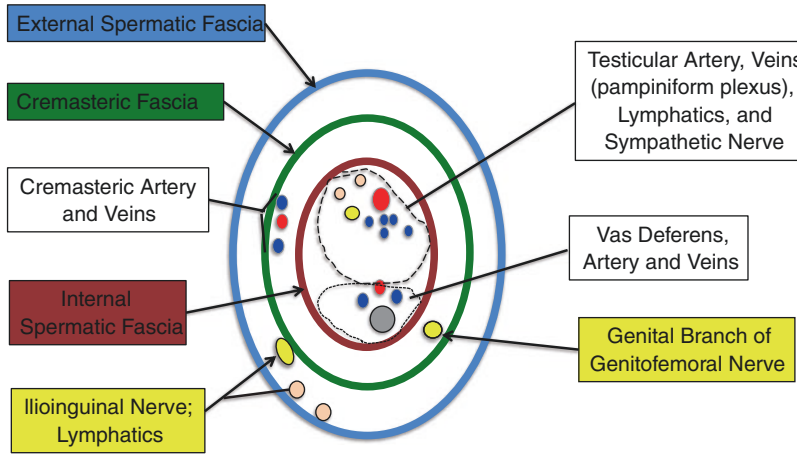
External Spermatic Fascia
Cremasteric Fascia
Cremasteric Artery and Veins
Internal Spermatic Fascia
Ilioinguinal Nerve; Lymphatics
Testicular Artery, Veins (pampiniform plexus), Lymphatics, and Sympathetic Nerve
Vas Deferens, Artery and Veins
Genital Branch of Genitofemoral Nerve

Fig. 21.2 Cross section of the spermatic cord. The ilioinguinal nerve and the genital branch of the genitofemoral nerve are both located superficial to the internal spermatic fascia. When dissecting the spermatic cord in a distal to proximal direction, the fascia layers superficial to the internal spermatic fascia (external and cremasteric fascia) can be swept off of the cord, to preserve the ilioinguinal and genital branch of the genitofemoral nerves

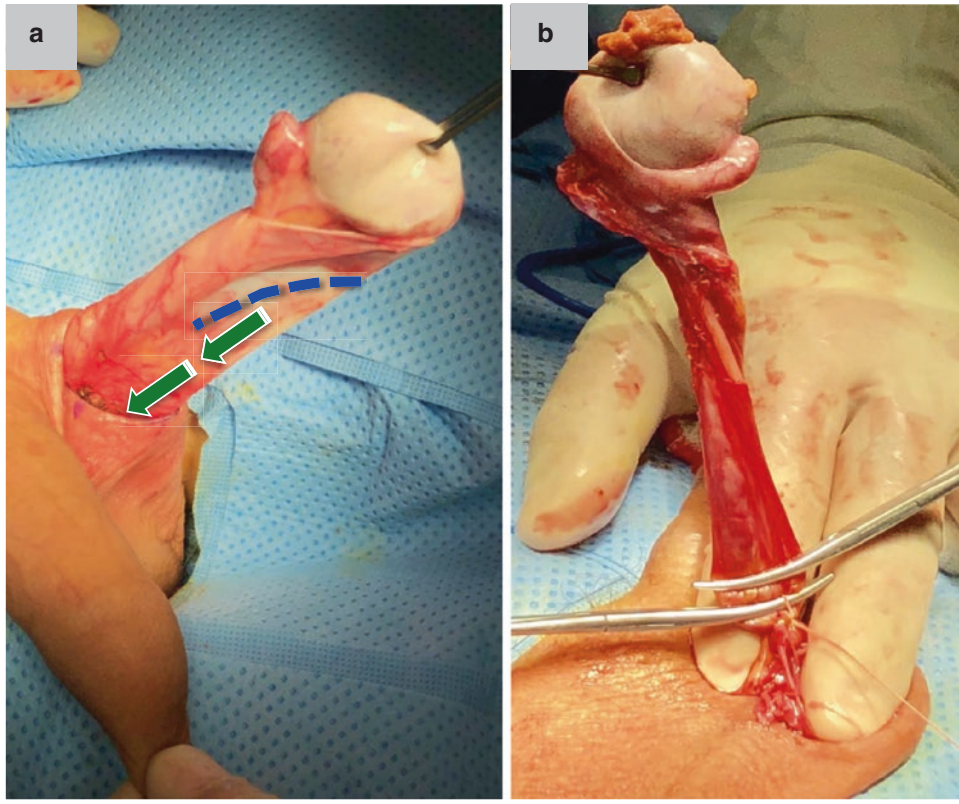

Fig. 21.3 (**a**) The testicle and cord are delivered into the wound by incising the parietal layer of tunica vaginalis via the perineal incision. The testicle surface (the testicle's investing *visceral* layer of tunica vaginalis) is placed to tension. The superficial-most layers (visible here) are the external spermatic fascia, beneath which is the cremasteric muscle fibers/cremasteric fascia. These are incised distally (blue hatch line) and then swept with a 4x4 gauze proximally to reflect them off of the remainder of the spermatic cord (internal spermatic fascia and its contents). These are preserved. (**b**) After the cord is stripped to the internal spermatic fascial layer, it is clamped proximally. We inject 10 cc. of 0.5% Marcaine into the cord proximal to the clamp, to acheive regional anesthesia, and then the cord is suture ligated with *absorbable* (2-0 Vicryl) suture

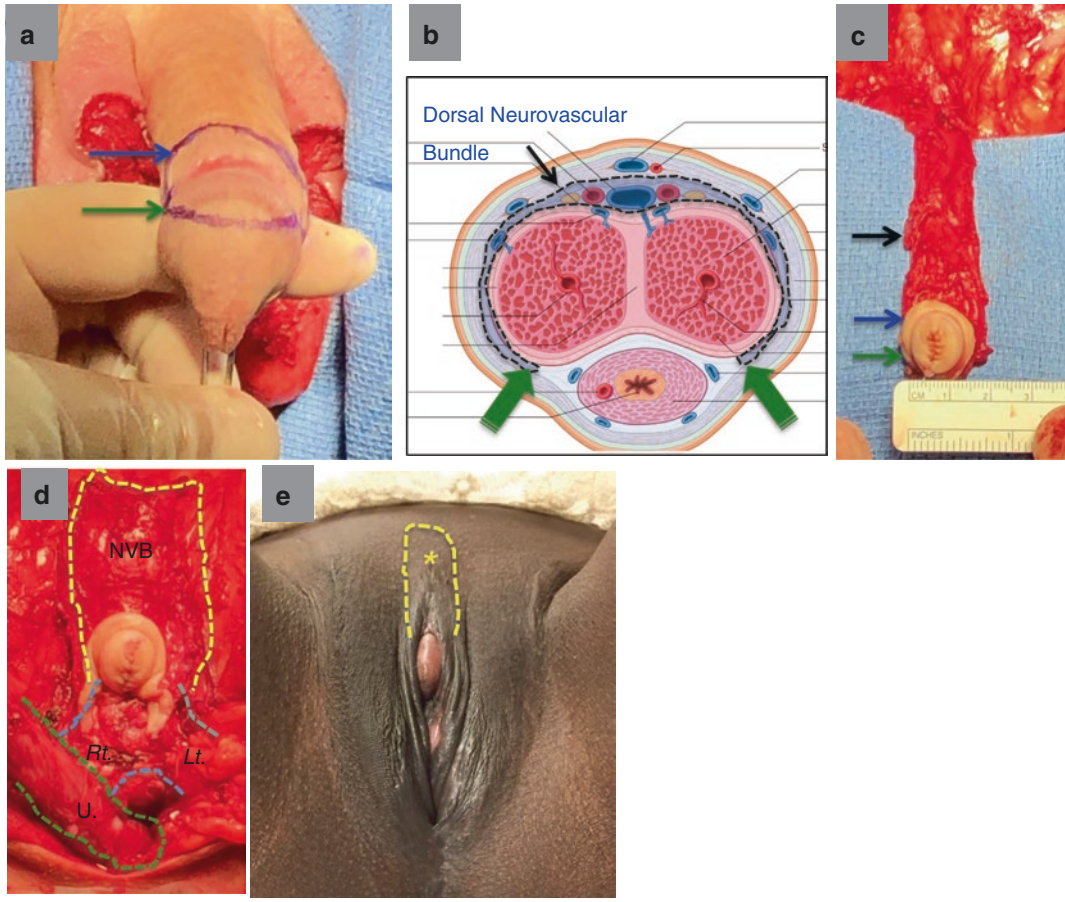

Fig. 21.4 (**a**) A small portion of the glans/glans coronal ridge is outlined for preservation for use to create the neoclitoris. We also preserve a 1 cm. margin of distal shaft skin, for use to create the inner aspect of the clitoral hood. (**b**) Penis cross section showing the neurovascular bundle. To maximize how many nerves and branches are preserved, we incise Buck's fascia longitudinally at the junction of urethra and the lateral surface of the corpora (*green arrows*). (**c**) The clitoris (*green* arrow), cuff of penile shaft skin (*blue* arrow), and NVB (*black* arrow). The NVB is as long as the penile shaft. (**d**) The clitoris is secured to penile shaft stump, midline to the *right* and *left* crura, and urethra (U). The NVB is folded in half and secured to midline pre-pubic fascia. (**e**) The folded NVB (location: yellow hatch line) can be stimulated directly to achieve orgasm

(Fig. 21.4b, *green arrows*). We then use tenotomy scissors to dissect the NVB *entirely* off of the tunica in a dorsal direction [9, 10]. It is imperative to not injure the dorsal arteries within the NVB during this dissection as these supply the glans tissue from which the neoclitoris is constructed (Fig. 21.4c). Depending on the degree of injury to both dorsal arteries, injury may result in partial or complete necrosis of the neoclitoris. An alternative technique that some surgeons use, presumably to guard against iatrogenic injury to the NVB during this delicate dissection, is to incise the tunica lateral to the NVB, leaving tunica adherent to the NVB intact. This avoids having to dissect between NVB and tunica, which increases risk of injury to nerves or the dorsal arteries. However, a potential limitation of this technique is that, depending on how much tunica is preserved, the resulting packet of tissue (NVB plus tunica) is often bulky. Any residual spongy tissue adherent to the undersurface of the tunica makes the tissue packet even bulkier. In some cases this makes the clitoris area overly prominent, and patients may com-

plain that the bulky appearance aggravates genital gender dysphoria and as a result interferes with sexual function.

Erogenous Sensation of the Vulva

Anatomy teachings suggest that the tactile sensory innervation of the tissues that comprise the vulva (excluding the clitoris) comes from the ilioinguinal and genitofemoral nerves [11]. The erogenous sensory innervation of the penis, other than the innervation of the penile glans, is not well described in the literature. Presumably, any tactile/erogenous sensation from penile shaft skin (from which the labia minora and peri-clitoral/urethra skin) is carried by afferent sensory branches of the dorsal sensory nerves of the penis. However, we must consider that the vast majority of these nerve branches would have been *cut* when the penile shaft skin is de-gloved from the penis during vaginoplasty.

Our patients *unequivocally* endorse tactile and some erogenous sensation of not only the clitoris area after vaginoplasty but also the vulva [9]. Furthermore, a small number of tertiary referral patients that had lost their entire clitoris to infection or surgical misadventure after vaginoplasty have reported the ability to achieve orgasm by stimulation of their midline vulva area (despite complete absence of a clitoris and presumably most of the NVB). These observations force the question: where does the erogenous sensory innervation of the midline of the vulva come from?

We Hypothesize that Erogenous Sensation of the Vulva Arises from Three Factors

1. The proximal ends of erogenous sensory branches of the dorsal nerves to surrounding area skin, which are cut when the penis is de-gloved, likely heal and innervate skin rearranged over the NVB.
2. Neuroplasticity, at the level of the CNS, can allow for rearrangement of processing centers to change how they interpret sensory input: input from tissue previously only "tactile" can become "erogenous" after surgery.
3. Decreased genital-related gender dysphoria (e.g., *after* gender-affirming genital surgery) may have a *permissive* effect, at the level of the CNS, on the ability for the patient to achieve erogenous sensation, resulting in new and/or improved sexual function.

This may explain how when erogenous tissues/nerves are lost, surrounding areas seemingly "develop" either amplified, or altogether new erogenous sensation (even capable of yielding orgasm) over time. If correct, this hypothesis also explains why our recommendation to patients that they stimulate their new genital anatomy frequently and using diverse stimuli (light and firm touch in varying patterns, alternating vibratory patterns, and with alternating temperature) would make sense based on what is known about neuroplasticity.

Erogenous Sensation Related to the Prostate and Vaginal Canal

In our experience performing vaginoplasty with creation of a vaginal canal, patients do not typically ascribe erogenous sensation to direct stimulation of the vaginal canal itself in contradistinction to erogenous sensation from the anterior distal end of the vaginal canal space corresponding to stimulation of the prostate gland or the perineum, which are known to be highly erogenous for many patients pre-operatively [6, 9]. Patients *do* endorse the sensation of "fullness" in their vaginal canal with receptive intercourse or insertion of a dilator, which can be pleasurable, but the vast majority report no specific sensation from the canal itself.

From an anatomic perspective, there is no available clear evidence that the epithelium used to line the neovaginal canal itself is erogenous. If the vaginal canal is lined with penile shaft skin alone (penile inversion), it is unlikely that the sensory nerves to the distal end of the penile skin tube remain intact, and, if vaginoplasty is performed with scrotal full-thickness free skin grafts, it is not known what erogenous nerves the skin, once healed, would become innervated by. Therefore, when we discuss expectations from surgery results during pre-operative discussion,

we explain to patients to expect sensation, and possibly a degree of erogenous sensation in their vaginal canal, but that erogenous sensation from solely the vaginal canal itself is less commonly reported. The *majority of erogenous sensation* from their vagina will result from stimulation of the clitoris and external vaginal (vulva) areas.

Practical Considerations for Patients Regarding Sexual Function After Vaginoplasty

Location of Erogenous Sensation

In our clinical experience, patients who are capable of achieving orgasm before vaginoplasty surgery, and whose birth genital anatomy is without anomalies, should expect to be able to achieve orgasm post-surgery of quality equal to pre-surgery [9].

Nearly all patients report hypersensitivity of the neoclitoris for generally ≥3+ months after surgery [9].

We *fold* the redundant NVB vertically at midline immediately cephalad to the neoclitoris' glans. Our group made the first report that this folded segment of NVB, when stimulated directly, is in fact highly erogenous and, with direct stimulation that excludes the clitoris, is capable of resulting in orgasm of equal intensity and overall quality as *before* vaginoplasty [9] (Fig. 21.4c, d and e).

Vaginal Lubrication and Hygiene

Patients should be informed that after vaginoplasty surgery they should not expect that their vaginal canal will self-lubricate with arousal because the epithelium lining the vaginal canal (penile, scrotal, or intestinal) does not naturally produce the transudate that cis-women's vaginas secrete to achieve natural lubrication with arousal. Instead, patients should be encouraged to use lubricant products during intercourse as needed. Use of peritoneum has been described as a source of tissue lining for the vaginal canal, and it has been suggested that this tissue is "naturally lubricating" with arousal though to date there is no Level I evidence that this occurs. The medical literature yields no scientific explanation for how peritoneal tissue would secrete fluid (presumably a transudate) with sexual arousal. Studies of patients who have undergone peritoneal vaginoplasty, focusing on whether neovaginal peritoneal tissue is secretory at all and/or in response to sexual arousal, are warranted [10].

Hygiene of the neovaginal canal can also affect sexual function. Some patients endorse anxiety about whether their vagina has a negative odor or foul-smelling vaginal discharge, and what effect this might have on partner interest in sexual activity. It is useful to explain to patients that a vaginal canal lined by skin (e.g., penile or scrotal) will be dependent on washing with water to maintain hygiene, as dead skin cells, oils, and sweat that accumulate within the canal will result in bacterial overgrowth and odor. It is our experience that vaginal canals made using intestine (colon) in fact have *little to no* odor, likely because intestinal tissue maintains immune function and has natural absorptive capabilities [2, 10].

Risk of Injury: Vaginal Depth, Male Partner Penile Length, and Sexual Positions

Whatever epithelium is used to construct the neovaginal canal (penile/scrotal skin, intestine), none are especially elastic such that the vaginal canal could reasonably be expected to *stretch* to accommodate a penis of significantly greater length than the vagina's depth. Our clinical experience suggests that the lining of the neovaginal canal *can* tear (and bleed) relatively easily. Penile skin and scrotal skin grafts are in fact quite thin. Intestinal mucosa is also quite thin and appears to be even more delicate than penile skin regarding damage from abrasions or shear stress. For these reasons, we suggest to our patients that they know what their own vaginal depth is but also that they have a clear sense of the appearance of a penis of equal, less, and greater length. This allows patients to take greater precautions when sexually active with a penis (or toy) that is longer than the depth of their vagina [6, 8, 12].

Sexual positions during vaginal-receptive intercourse can also result in injury to a patient's

neovagina. During initial sexual activity encounters after vaginoplasty, to minimize risk and allow patients to gain a clearer sense of which positions are (for *their* body) more and less risky, we encourage patients to utilize sexual positions that carry minimal to no risk of uncontrolled pressure or trajectory. With experience, patients can broaden their activities safely.

Sexual Function After Masculinizing Genital GAS

Considerations that impact sexual function following genital gender-affirming surgery include both surgical and anatomic factors. These should be considered by surgeons both in the course of genital surgery and during discussion with patients about surgical options, surgical risks, and benefits. Ultimately, while some of the content below is presented for consideration by surgeons, all details should be discussed with patients in order to provide education to them that facilitates informed decision-making. Factors that can affect sexual function are discussed below.

With all patients undergoing genital gender-affirming surgery, we review the pre-/post-surgery sexual function rehabilitation protocol discussed above. Provided that each patient is comfortable with the details of the protocol and sufficiently recovered to start the protocol, we encourage that they do and to report any difficulties or concerns.

Surgical Considerations to Maximize Genital-Erogenous Sensation

Choice for Phalloplasty Donor Site: In our experience, the radial artery forearm flap is superior to the ALT and suprapubic and groin skin donor sites for the following reasons [2, 13–15]:

1. Suprapubic and groin-flap donor sites yield flaps that have limited to no sensory innervation along the shaft distal to the base of the phallus [1, 2, 16].
2. The *sensory innervation* of the forearm is, anatomically, more extensive than for the skin of the anterior lateral thigh [11, 17, 18]. The medial and lateral antebrachial cutaneous nerves of the forearm provide sensory innervation to most areas of the flap, and when these nerve ends are coapted to the proximal end of the clitoral nerve, the result is erogenous sensation to the phallus, which is on average *superior to what*, in our experience, is achieved with an ALT flap. The sensory innervation of an ALT flap is based on the *lateral femoral cutaneous* nerve. It can vary in size, number of branches, and location. Occasionally the ALT flap can contain fewer sensory nerve branches than expected [17, 18].
3. A radial artery forearm flap yields a flap whose final tubularized *girth* is generally between 10 and 13 cm [1]. This size is height/size appropriate for the average man. With an ALT flap, it is often a challenge to make the final flap girth *less than* 13–15 cm. *maximum*, because the thickness of an ALT flap is significantly greater than the thickness of a radial artery forearm flap [1]. When, during surgery, it is clear that an ALT flap will yield an overly thick phallus, the surgeon must decide either to attempt to thin the flap (i.e., cut away excess adipose tissue within Scarpa's fascia, which risks injury to perforator vessels and/or denervation of the flap) or to proceed and construct the phallus as is but risk the patient being dissatisfied with the resulting excess girth. As we have reported previously, phallus girth greater than 13–15 cm is likely to cause discomfort with insertion into the receptive partner (Fig. 21.5) [19].
4. Anatomic variation with respect to the presence and number of vessels and sensory nerves is much less common with a forearm flap as compared to an ALT flap [10]. The sensory innervation of a radial artery forearm flap is provided by the medial and lateral antebrachial cutaneous nerves, which are reliably located in close proximity to the basilic and cephalic veins, respectively [11] (Fig. 21.6).

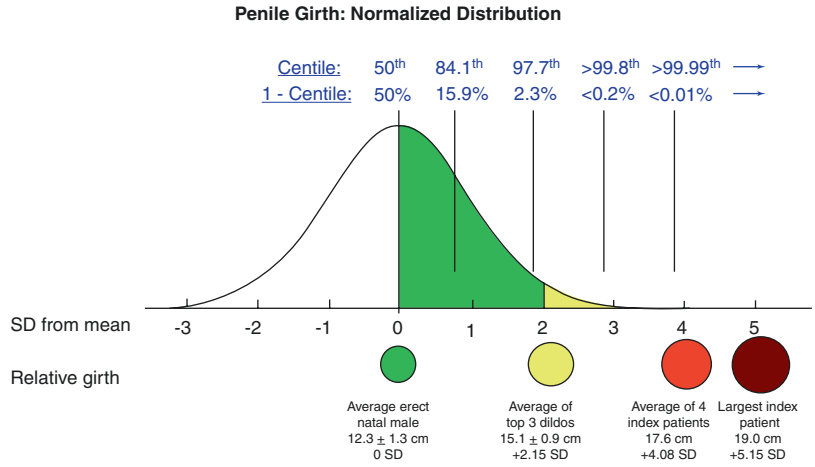
Penile Girth: Normalized Distribution
Centile: 50th 84.1th 97.7th >99.8th >99.99th
1 - Centile: 50% 15.9% 2.3% <0.2% <0.01%
SD from mean
-3 -2 -1 0 1 2 3 4 5
Relative girth
Average erect natal male 12.3 ± 1.3 cm 0 SD
Average of top 3 dildos 15.1 ± 0.9 cm +2.15 SD
Average of 4 index patients 17.6 cm +4.08 SD
Largest index patient 19.0 cm +5.15 SD

Fig. 21.5 Mean erect penis girth among cis-gender men is 12.3 cm. The mean girth of the largest three top-selling dildos in the United States is 15.1 cm. Work by Isaacson et al., 2017, suggests that neophallus girth (like dildo girth) ≥ 15.1 cm exceeds what a receptive partner can accommodate comfortably

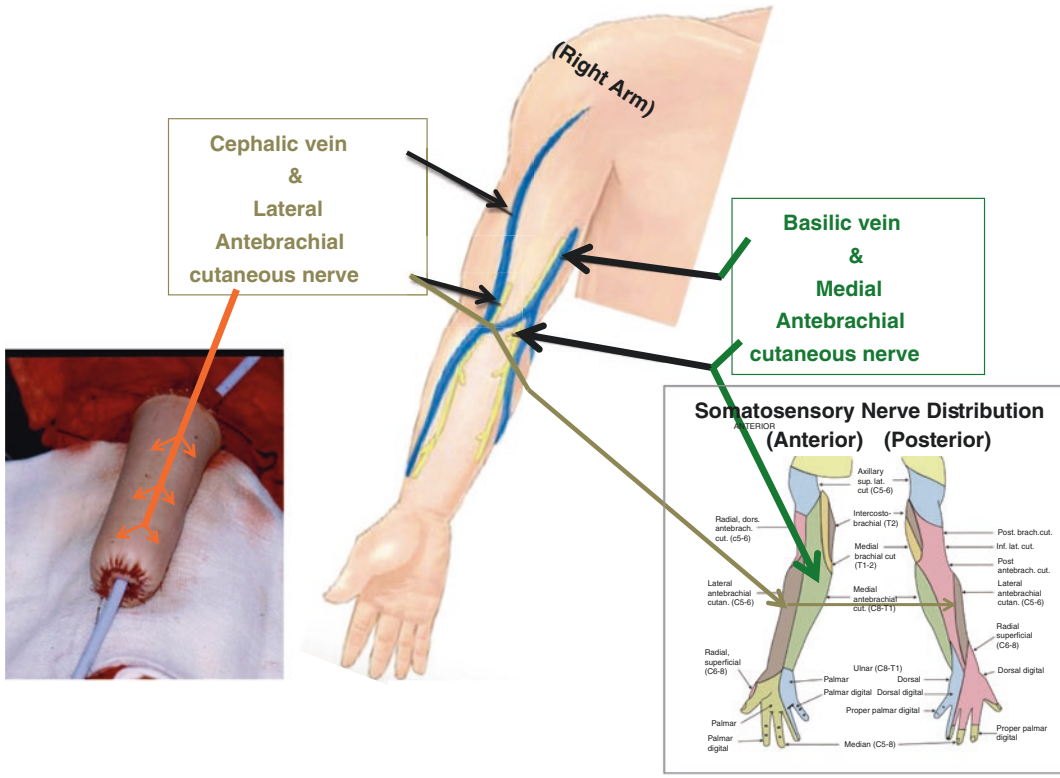

Fig. 21.6 The *lateral antebrachial cutaneous nerve* is commonly found just medial to the cephalic vein (*left black arrows*). The somatosensory distribution of the lateral antebrachial cutaneous nerve on the forearm (*brown arrows*) is the skin closest to the *radius bone* of the forearm, which is the portion of the flap typically used to create the neophallus shaft (*orange arrows*). In contrast, the *medial antebrachial cutaneous nerve* (commonly found immediately lateral to the basilic vein; *right black arrows*) has a somatosensory distribution localized to the *skin of the anterior forearm* located medially, over the *ulna bone* (*green arrow*). This skin from this portion of the flap is typically used to construct the neourethra, which receives no direct tactile stimulation during either masturbation or intercourse. For this reason, we prioritize dissection of the *lateral antebrachial cutaneous nerve and* anastomosis of it to the proximal end of the recipient (single) clitoral nerve. (In order to maximize erogenous sensation of the entire phallus, whenever feasible, we anastomose *both* the *medial and lateral antebrachial cutaneous nerves* to the recipient clitoral nerve)

In contrast, the sensory innervation of an ALT flap is from the lateral femoral cutaneous nerve [2, 10]. The location of this nerve can have a more variable trajectory across the location of the flap such that it is possible that upon mobilization of the flap some or all of the flap may not carry sensory innervation. Alternatively, the nerve may be present, but diffuse, such that if the flap is mobilized as a free (versus pedicle) flap, the nerve's root(s) may be too small to coapt to the proximal segment of one of the two clitoral nerves, as is discussed in the next section.

Erogenous Sensation: Erogenous sensation of a phallus made from either a radial artery forearm flap *or* an anterior lateral thigh flap (ALT) *can* be achieved by two methods:

1. Coaptation of the sensory nerves of the flap (medial and lateral antebrachial cutaneous nerves of the radial artery forearm flap and the lateral femoral cutaneous nerve of the ALT flap) to the proximal transected end of one of the two clitoral nerves. The sensory nerve distribution of the *lateral* antebrachial cutaneous nerve will correspond to the portion of the flap that is destined to be the phallus *shaft* skin, whereas the portion of the flap innervated by the *medial* antebrachial cutaneous nerve is destined to be the *urethra* portion of the phallus [2] (Fig. 21.6). Some surgeons will coapt one or more of the transected sensory nerves from the flap not only to the proximal end of one of the transected clitoral nerves but also to the *ilioinguinal nerve* [20]. It is our practice to coapt as many sensory nerves from the flap to one of the clitoral nerves, as the clitoral nerve already maps, at the level of the CNS, to tactile *and* erogenous sensory afferent input. In contrast, the ilioinguinal nerve maps to the upper medial thigh and mons-pubis area in cis-gender female anatomy, which are significantly less erogenous than the clitoris. When one of the two clitoral nerves is insufficient to coapt all of the flap sensory nerves, we will utilize the ilioinguinal nerve. While patients who have undergone coaptation of the sensory nerve to the ilioinguinal nerve report feeling the presence of their penis in their thigh area, this does resolve with time, suggesting that at the level of the CNS, re-mapping of sensory centers occurs to match the patient's new anatomy.

2. Transposition of the native clitoris glans and shaft to a superficial sub-cutaneous location at the ventral base of the phallus, where the clitoral structures can be easily stimulated during masturbation *and/or* insertive intercourse. Previous work by our group found that patients who underwent transposition of the clitoris to the base of the phallus reported *no decrease* in sensation at the native glans clitoris or change in orgasm quality from its direct stimulation after it is transposed to the base of the phallus [2].

By these two strategies (1 & 2 above), it is possible for patients who have undergone phalloplasty to achieve orgasm from their penis with insertive intercourse [6, 10].

Genitourinary Prosthetics: Decision-making about genitourinary (GU) prosthetics is important because complications regarding these are morbid [21–23]. The most feared adverse event regarding prosthetics is infection of the prosthetic, which invariably requires explant of the prosthetic device and often results in scarring and some degree of shrinkage of the phallus or scrotum. Salvage surgeries wherein a new, sterile device is implanted are *not* recommended, as the host tissue prosthesis site does not have compartmentalized anatomy that might otherwise help protect the device from collaterally located infection (e.g., a neophallus does not have the tunica-defined compartment of the corpora cavernosa as in a cis-gender penis or the protective tunica and dartos layers of a cis-gender scrotum) [6, 10]. In a transgender man, a penile prosthesis must be secured to the patient's pelvis bones. We use only inflatable penile prostheses, as these have a much lower risk of erosion than malleable prostheses. We secure the prosthesis cylinder to the patient's pelvis by placing the proximal end of the cylinder into a tube-shaped segment (a "sock") of Dacron graft material (20-mm-wide Dacron vascular graft) sutured securely around the cylinder (Fig. 21.7). We then suture the Dacron "sock" to the patient's ischial ramus using 2-0 Ethibond sutures.

Another risk factor to consider with neophallus prostheses is that in a phallus, there is no anatomic barrier from the neourethra, which means that any fistula or local infection stemming from the urinary tract risks infection of the penile prosthesis.

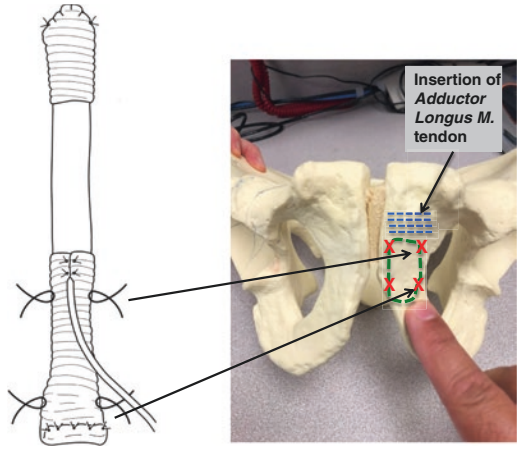

Fig. 21.7 Inflatable penile prosthesis for a neophallus. To secure the inflatable penile prosthesis cylinder to the patient's body, the proximal and distal ends are wrapped in a "sock" and "cap" (respectively) made of Dacron (*left*). The more proximal "sock" is sutured to a flat area of the ischiopubic ramus (*right, outlined in blue*) in four locations (*marked by Red X's*), located just posterior to the insertion site of the adductor longus muscle tendon using permanent (e.g., 2-0 Ethibond) sutures

Furthermore, the tissues of a neophallus or neo-scrotum are not as well-perfused (and thereby protected by the immune system or presumably by systemic antibiotics) as a cis-gender penis.

Testicle Prosthesis Size: We advise patients to elect implant of testicle prostheses of a size *small enough* that allows for a competent three-layer wound closure. Not uncommonly, the neoscrotum is not sufficiently capacious to allow for implant of one or two large-size (20 cc) testicle prostheses. In such cases, when patients desire large-sized testicle prosthesis, we advise implant of the largest testicle prosthesis that will fit reliably, with a plan to allow the operative site to heal adequately before upsizing the testicle prostheses (typically at least 3–4 months later) with a larger testicle prosthesis [2].

Inflatable Penile Prosthesis Type and Size

Current penile prosthesis options for transgender men are limited to devices designed and manufactured for cis-gender male anatomy. These include inflatable penile prosthesis (IPP) devices (2-piece and 3-piece) and malleable devices [24].

Regardless of what penile prosthesis type is used, any implanted penile prosthesis must be anchored to the patient's body, to prevent the device from migrating and eroding through the walls of the phallus or into the neourethra [2]. We use inflatable devices exclusively (almost always only *single* cylinder) and we anchor the cylinder to the anteromedial aspect of the obturator ramus (just medial and posterior to the insertion of the *adductor longus* tendon) by securing the proximal end of the cylinder within a Dacron "boot" and then suturing this boot to the flat surface of the bone of the obturator ramus using non-absorbable Ethibond suture or bone screws connected to non-absorbable mono-filament suture [2].

We believe that use of inflatable penile prostheses is superior to use of malleable devices and affords better clinical long-term outcomes. This is so for two important reasons:

1. An inflatable device, in the flaccid state (which is representative of the majority of the time the device remains inside the patient), is softer and occupies significantly less volume than a malleable cylinder, thereby reducing local pressure-related ischemic necrosis of the adipose tissue that comprises nearly all of the interior of the phallus. With semi-rigid malleable devices, any position that the patient assumes in the awake or sleeping state compresses the phallus tissues against the cylinder, thereby accelerating ischemic pressure necrosis of the interior of the phallus which results in a "flabby" phallus. The more "flabby" the phallus is, the less tissue support there is for the cylinder, and therefore the more likely it is that the end of the semi-rigid cylinder will erode through the (typically distal end) of the phallus [21].
2. However a malleable penile prosthesis is anchored to the patient's body, the net vector force of the device on the phallus is directed to the dorsal aspect of the phallus. This, combined with the fact that the phallus "hangs" on the penile prosthesis cylinder, results in

increased risk of erosion of the cylinder through the *dorsal aspect* of the phallus—most especially where the tip of the cylinder is located: at the distal end of the phallus [6].

Number of Cylinders: Penile prosthesis placement in a cis-gender penis always includes implant of two cylinders into the interior of each corpora cavernosa, which is enveloped by the thick tunica of the corpora. Cis-gender corporal anatomy not only eliminates lateral-wise movement and sheer-stress of the device but also serves to protect the urethra from the cylinders by excluding the dorsally located cylinders from the ventrally located urethra. With any neophallus, the interior of the phallus has *no* internal compartments, and the cylinder will directly abut the somewhat centrally located neourethra and its pedicle [21]. Unless the girth of a phallus is especially great, there is relatively little room for two cylinders, and implant of two cylinders risks impingement of the cylinders upon the urethra and its vascular pedicle. Furthermore, the presence of two cylinders versus one amplifies the effect of phallus adipose tissue ischemic necrosis as described above.

We have found that use of a single inflatable cylinder yields sufficient on-demand rigidity to afford penetration while minimizing risk of injury/compression to the urethra and adipose tissue necrosis-related loss of girth/fullness.

Practical Considerations for Patients Regarding Sexual Function After Phalloplasty

Phallus Length: Decision-making related to phallus length is very important, as the desired length of the phallus defines the final length of the urethral and phallus portions of the flap and satisfaction regarding the final dimensions of the phallus is an important driver of overall satisfaction. Effective management of patient expectations is singularly important in this context. Beginning during discussions in clinic, we suggest that patients consider what phallus length they desire. We explain that mean *erect* penile length for cis-gender men is about 5 ¾ inches, while mean flaccid length is significantly shorter than this. We suggest that patients consider that upon insertion of an erectile device, if they so choose, their phallus will not increase in length and girth. Hence, the final length that they choose will be the length that their phallus exists in/as for the vast majority of the time. They should consider this, together with what resting length most men of the patient's size and height might have, so as to not appear vastly different from other men if this is something that they wish to avoid.

We explain that *excess* length risks compromising perfusion to the distal and proximal ends of the phallus (as these areas are furthest from the pedicle's vessels). We also explain that an excessively long phallus will be especially *heavy* and that excess weight could possibly cause it to migrate more posteriorly on the patient's pelvis, resulting in an overly posteriorly located phallus—which can result in discomfort [6].

Lastly, we *show* patients penis models of 4.5–6 inch*es* and suggest that they consider which length they most prefer in light of the aforementioned considerations. Use of penis models in clinic is especially useful, as many patients have reported to us that, for example, 5 ¼ inches when viewed as a penis model is substantially "larger appearing" than when considered using just a ruler, where proportional width and girth are not visualized.

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CHAPTER 13

Genioplasty

Bahman Guyuron and Adam Bryce Weinfeld

Summary

1. The labiomental groove is 4 mm deep in a woman and 6 mm deep in a man.
2. Riedel's Plane is an easily employed anthropometric construct used in the determination of the ideal projection of the chin. In a balanced face, this line, which is drawn by connecting the most projecting portions of the upper and lower lips, should touch the most projected portion of the chin.[1]
3. The canine is the longest tooth in the mandible (average length 25.5 mm). Horizontal osteotomies should be placed at least 5 mm caudal to the canines to avoid injury (30.5 mm). Osteotomy location should also be 5 mm caudal to the mental foramen to reduce the risk of injury to the mental nerve.
4. The mental foramen is located in a plane between the first and second mandibular premolars.
5. Patients who have a deep labiomental groove often have an Angle class II occlusion and may gain more benefit from orthognathic surgery than genioplasty.
6. Intraoral incisions should be placed 1 cm anterior (labial) to the gingivolabial sulcus in order to maintain sufficient soft tissue for secure wound closure.[1]
7. Augmentation genioplasty with an implant is preferred in the older patient with mild horizontal deficiency, while an osteotomy is a better choice for a younger patient.
8. Patients with Angle class III and Angle II malocclusion require consideration of orthognathic surgery in addition to or instead of genioplasty.
9. Augmentation genioplasty performed through a submental incision may reduce the risk of cephalic migration, wound dehiscence and infection.
10. Most complications of alloplastic genioplasty are successfully treated with removal of the implant and osseous genioplasty.[1–3]

INTRODUCTION

The chin is the lower topographic limit of the face and thus plays an important role in the perception of appropriate facial proportions.[4,5] A vertically deficient or excessive chin places the lower third of the face out of balance relative to the middle and superior thirds of the face.[6] Horizontal deficiency or excess diminishes facial pulchritude, most notably in profile (Figs 13.1 & 13.2). Additionally, the chin has a pivotal role as a reference in the appreciation of other facial features, most notably the nose. A large nose is often paired with a deficient chin and they have a reciprocally negative effect on the appearance of each other and on overall facial attractiveness (Fig. 13.3).[7–9]

Improvements in the chin can be achieved by osteotomy or by the use of implants or grafts for augmentation.[10] Osseous procedures include burr reduction (ostectomy), osteotomy with caudal segment repositioning, osteotomy with grafting or osteotomy with segmental sectioning.[11–15] Augmentation genioplasty can be accomplished with autologous tissue grafts such as bone or cartilage or, more commonly, with alloplastic implants.[16,17] The benefits of alloplastic augmentation include a shorter and less technically demanding procedure. However, alloplastic genioplasty can pose limitations in achieving large augmentation without causing lip retraction, has a lower success rate for correction of asymmetry and offers very limited potential to change the vertical dimension of the chin.[18]

ANATOMY

From external to internal, the layers of the chin include skin, subcutaneous fat, muscles, periosteum and bone. The depressor angularis, depressor labi inferioris and mentalis attach to the anterior plane of the chin. The geniohyoid, genioglossus, mylohyoid and anterior belly of the digastric attach to the lingual aspect. Following elevation of the anterior periosteum and horizontal osteotomy, the blood supply of the caudal chin segment is maintained via terminal lingual artery periosteal perforating branches that travel through the musculature attached to the lingual side (Figs 13.4 & 13.5).

The mental nerve supplies sensation to the anterior mandibular gingiva, mucosa and lower lip. It is a continuation of the inferior alveolar nerve and exits the mandible via the mental foramen. The mental foramen is located in the vertical plane between the first and second mandibular premolars. In the terminal portion of its course, as it travels posterior to anterior, the nerve ascends to the foramen (Fig. 13.6). This upward trajectory must be understood when planning the location and angle of a horizontal osteotomy.[19–21] In order to avoid direct nerve injury, the osteotomy should be placed at least 5 mm caudal to the foramen and be executed at a caudal-oblique angle.

INDICATIONS AND CONTRAINDICATIONS

1. Genioplasty is performed to address chin disharmony. It does not replace orthognathic surgery.
2. Augmentation genioplasty best serves the older patient with a mild-to-moderate horizontal defect. This does not imply that the use of osseous procedures for chin advancement in older patients is ill advised.
3. Advancement or augmentation genioplasty should be done conservatively on patients with long face deformities who do not wish to have maxillary intrusion.
4. Genioplasty is contraindicated in patients who have severe medical conditions that make surgical procedures unsafe.
5. Genioplasty should be avoided on patients whose dysmorphology would not be sufficiently corrected with an isolated genioplasty to provide patient satisfaction.

Fig. 13.1 Horizontal microgenia.

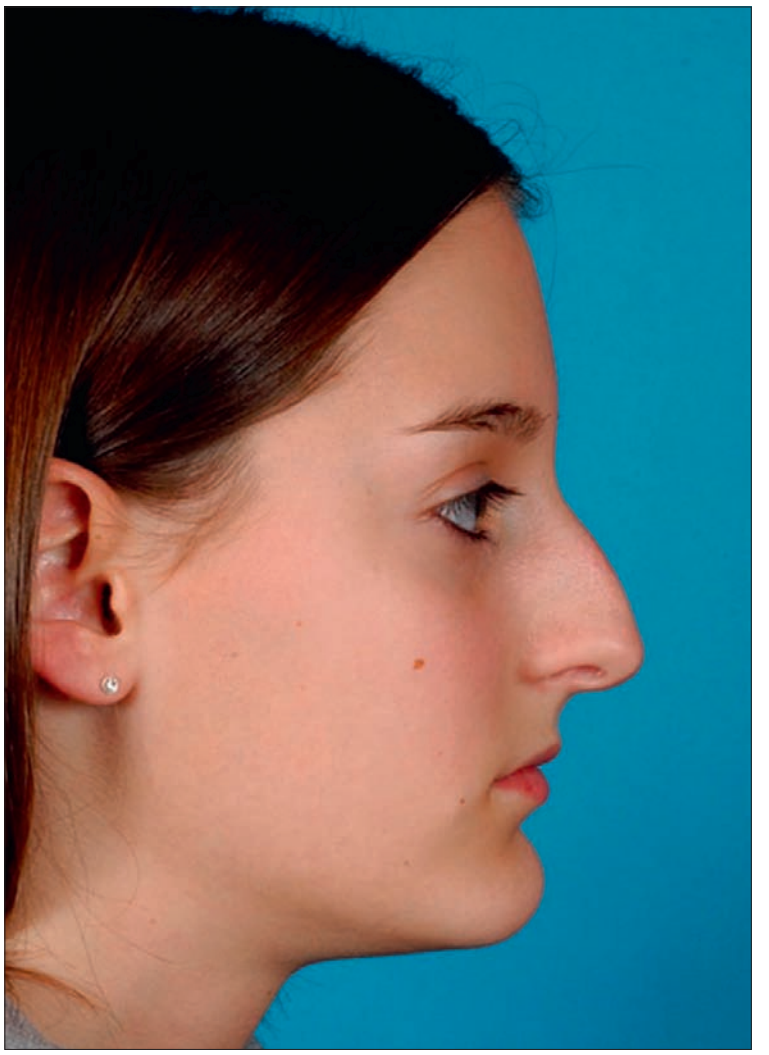


Fig. 13.2 Horizontal macrogenia.

The presence of some medical conditions influences the type of genioplasty that is prudent. Generally, patients with diabetes mellitus or immune deficiency are not ideal candidates for alloplastic augmentation.[1,22] Patients over the age of 60 years old with a mild-to-moderate horizontal microgenia are better candidates for alloplastic augmentation. On most other patients osteotomy is preferred, although the use of implants is not considered inappropriate. Patients who smoke cigarettes are not the ideal candidates for the use of grafts as a chin augmentation material.

PREOPERATIVE HISTORY AND CONSIDERATIONS

The cardinal determinants of chin harmony are its projection symmetry and vertical length. Assessment of the vertical dimension of the chin is performed first in frontal view analysis. The face is divided into two anatomic portions using imaginary lines placed at the eyebrow level and subnasale. The three segments that these lines create should be equal in the harmonious face (Figs 13.7 & 13.8).

To assess the vertical dimension of the chin, the lower third is further subdivided using a line passing through the stomion. The distance from the stomion to the menton should be twice the length of the distance between the subnasale to the stomion. Additionally, the distance from the stomion to menton should be equal to the distance from the stomion to the line connecting the medial canthi. Deviation from equality in either of these comparisons is measured in millimeters and included in the plan for vertical modification of the chin.

The terminus of the female chin is a single light reflfection. In the male chin, there are dual light reflections indicating the underlying increased width and rectangular shape of the chin. To determine the chin symmetry, a vertical line is drawn passing through the midglabella, the tip of the nose (as long as the nose is straight) and the philtral dimple. The midpoint of a symmetrically located chin will fall on this line (Fig. 13.9).[8] If chin asymmetry is identified, its cause should be elucidated as it impacts procedure choice. To decide whether the chin asymmetry is related to maxillary/mandibular disharmony or is intrinsic to the chin itself, the horizontal planes of the mouth and the eyes are examined. The intercommissural line should be parallel to the intercanthal line. Otherwise, vertical asymmetries of one or both of the jaws are likely to be present and genioplasty alone may not correct this condition fully. If the intercommissural line parallels the intercanthal line, a pure genial asymmetry is present and a genioplasty with osteotomy can be planned to correct the deformity (Figs 13.10 & 13.11).

Horizontal excess or deficiency is detected better in profile. There are multiple methods to determine ideal chin projection. The use of Riedel's plane is simple and practical. With the ideal chin projection present, the most projecting portion of the upper lip, lower lip and

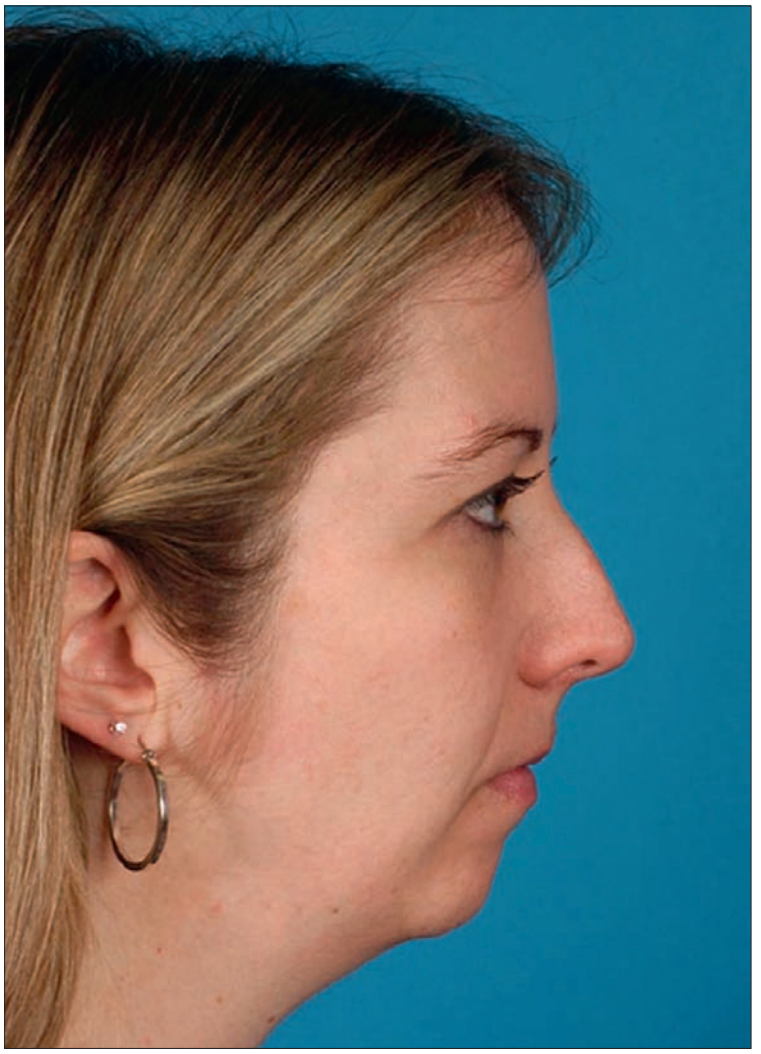


Fig. 13.3 The synergistic facial disharmony of a large nose paired with microgenia.

Fig. 13.4 Muscles that attach to the lingual aspect of the chin.

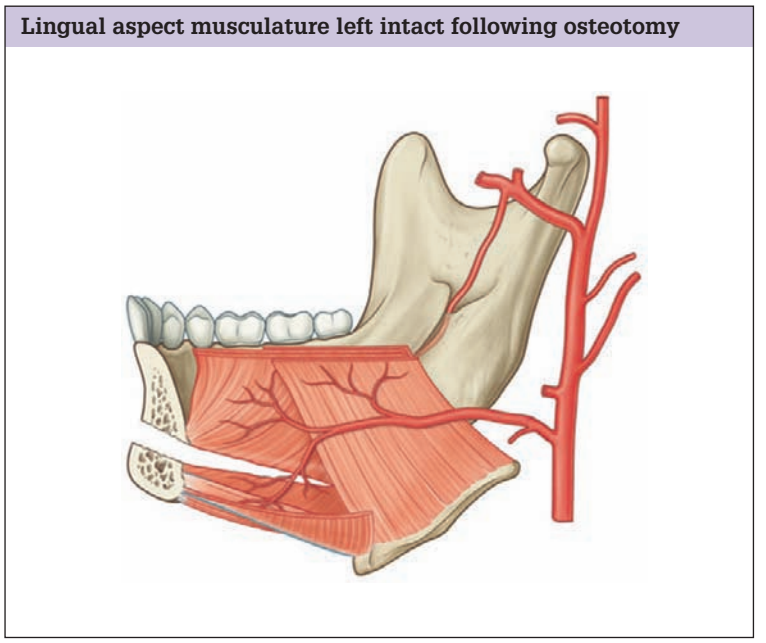


Fig. 13.5 Demonstration of lingual aspect musculature left intact following osteotomy to preserve blood supply to the caudal segment.

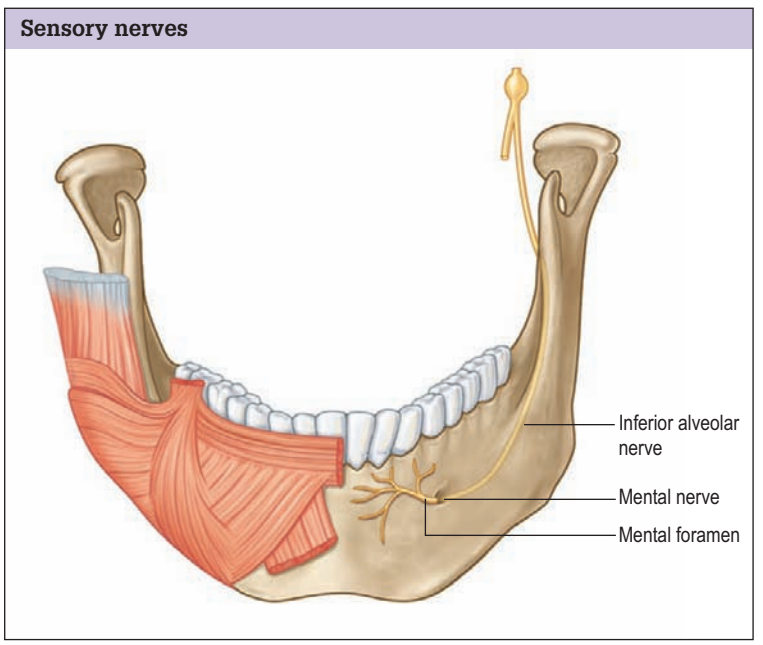
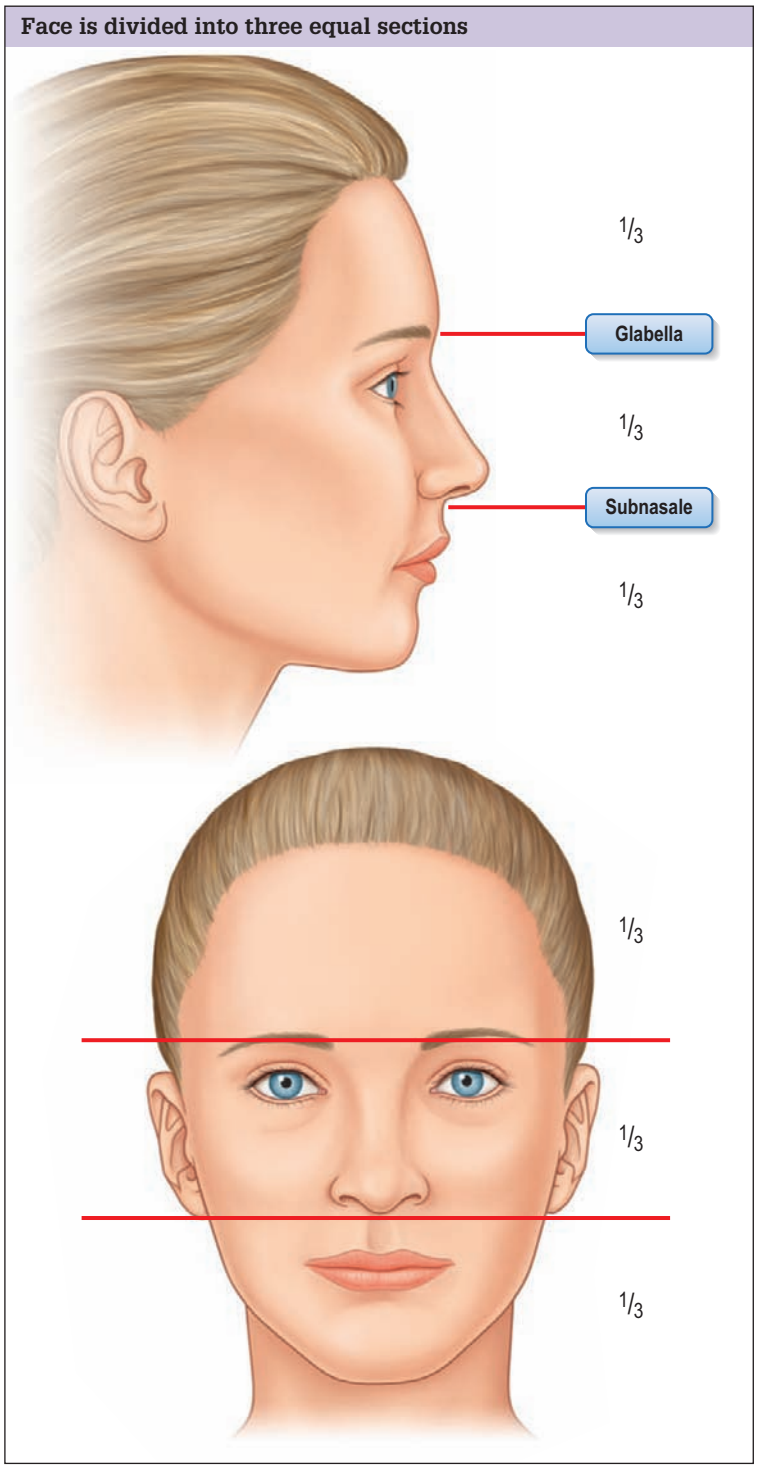


Fig. 13.6 Sensory nerves. The inferior alveolar nerve transitions to the mental nerve as it exits the mental foramen. Prior to this transition the nerve makes a brief pass caudally then cephalically to the foramen. Horizontal osteotomies are made at least 5 mm caudal to the mental foramen to reduce the risk of direct neural injury.

chin are all tangent to the same line (Fig. 13.12). If the chin lies posterior to the Riedel's plane, horizontal microgenia exists. If the chin lies anterior the plane, horizontal macrogenia exists.

The labiomental groove should be 4 mm deep in a woman and 6 mm in a man. A deficient chin with a deep labiomental groove should not be treated with augmentation alone in most incidences. These patients are better candidates for orthognathic surgery rather than genioplasty. Although independent of the associated pathology, a deep labiomental groove can also be treated by adding autologous fat, cartilage or bone grafts.

An intraoral examination is mandatory in the assessment of the potential genioplasty patient. The maxillary/mandibular occlusal relationship is carefully examined. Significant periodontal disease should



Figs 13.7 and 13.8 The face is divided into three equal sections by placing imaginary lines at the glabella and subnasale. Assessment of these divisions aids in the analysis of facial vertical proportions.

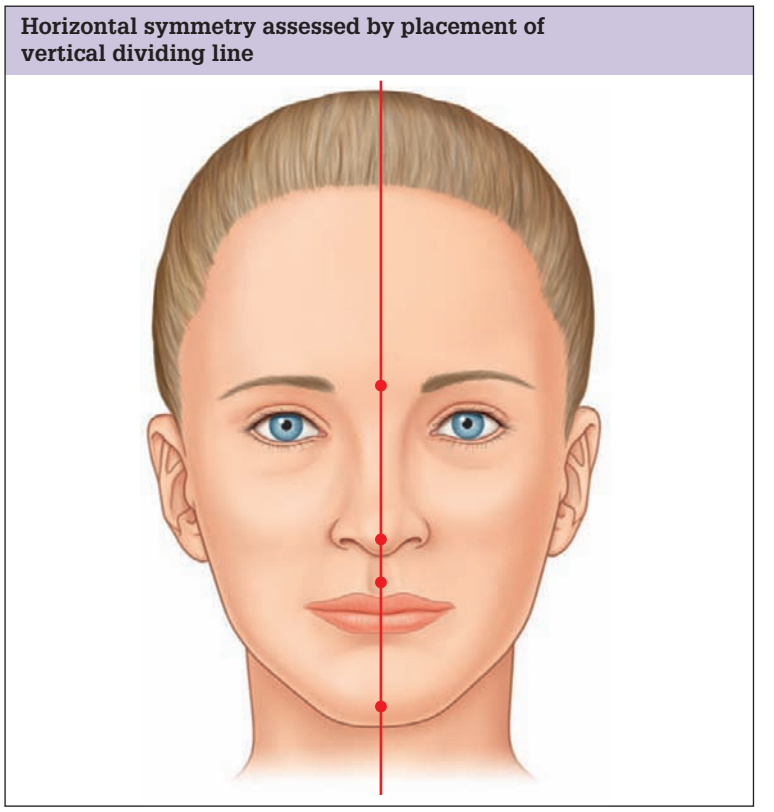


Fig. 13.9 Horizontal symmetry can be assessed by the placement of vertical dividing line. This line connects the midglabella, tip of the straight nose and philtral dimple. The topographic center of a symmetric chin will also lie on this line.

be identified and adequately treated prior to genioplasty to decrease the risk of infectious complications.

Life-size photography with soft tissue cephalometric analysis provides an opportunity for precise preoperative planning of augmentation or osseous genioplasty to the millimeter in both the vertical and horizontal planes.[23] A circumspect facial analysis, coupled with life-size photography, can lead to an accurate definition of chin dysmorphology.

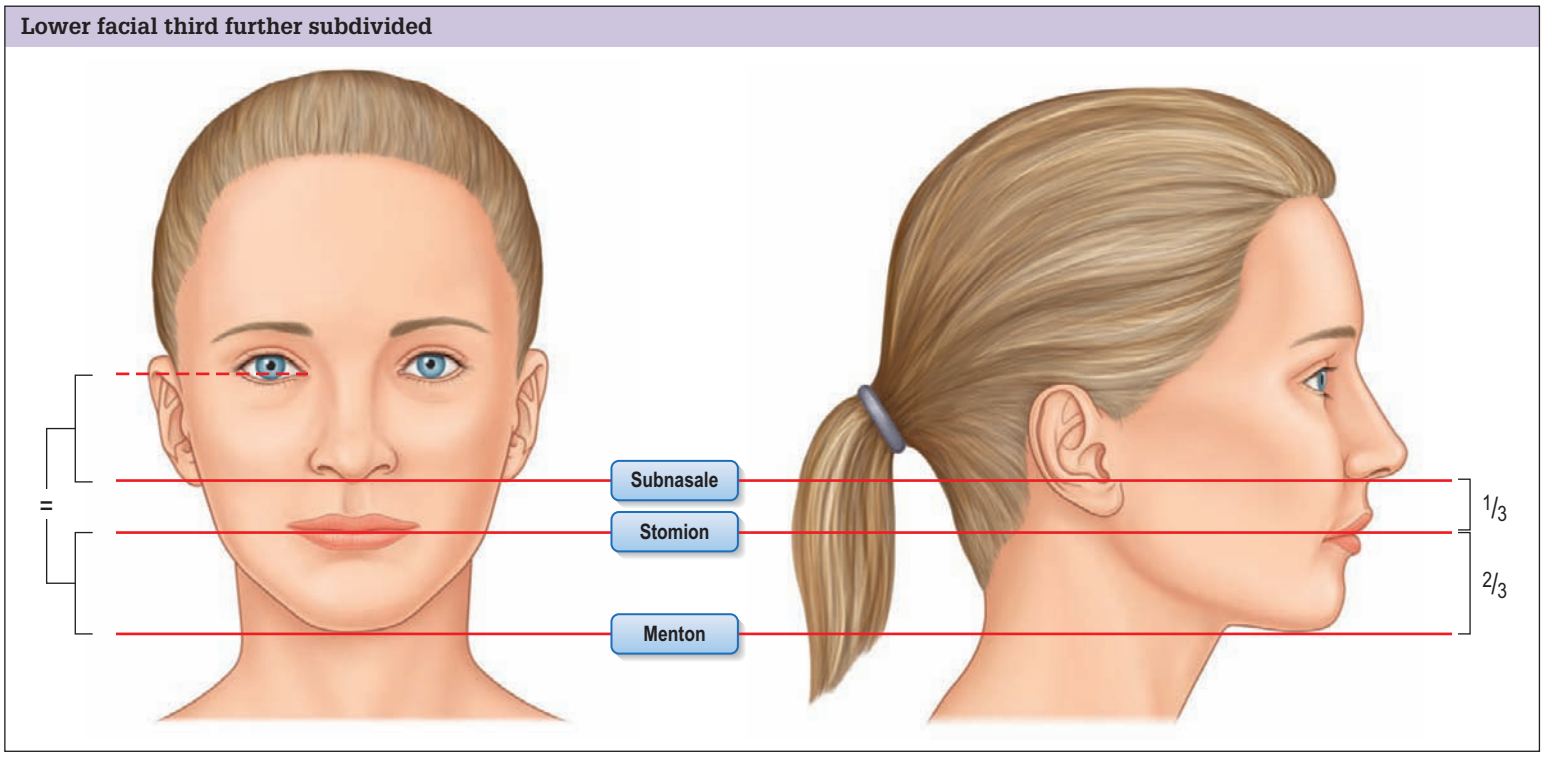
CLASSIFICATION OF CHIN DEFORMITY

Chin pathology is classified as types I–VII according to the prevailing boney or soft tissue abnormalities.[24] The type of deformity dictates which procedure should be utilized in order to attain a pleasing outcome (Table 13.1).

Table 13.1 Classification of chin deformities

Group I: Macrogenia Horizontal Vertical Combination
Group II: Microgenia Horizontal Vertical Combination
Group III: Combined microgenia and macrogenia (bi-planer defects) Vertical excess and horizontal deficiency Vertical deficiency and horizontal excess
Group IV: Asymmetric chin Normal anterior lower facial height Short anterior lower facial height Long anterior lower facial height
Group V: Pseudomacrogenia
Group VI: Pseudomicrogenia
Group VII: Witch's chin deformity

Group I deformities encompass macrogenic chins. Moderate-to-severe pure horizontal macrogenia is managed by setting back the caudal segment (Fig. 13.13). Correction of pure vertical chin excess requires resection of a horizontal block or wedge segment (Fig. 13.14).



Figs 13.10 and 13.11 The lower facial third is further subdivided into an upper one-third and lower two-thirds by placing a line at the stomion. The stomion to menton length is twice as long as the subnasale to stomion length when appropriate vertical chin height exists.

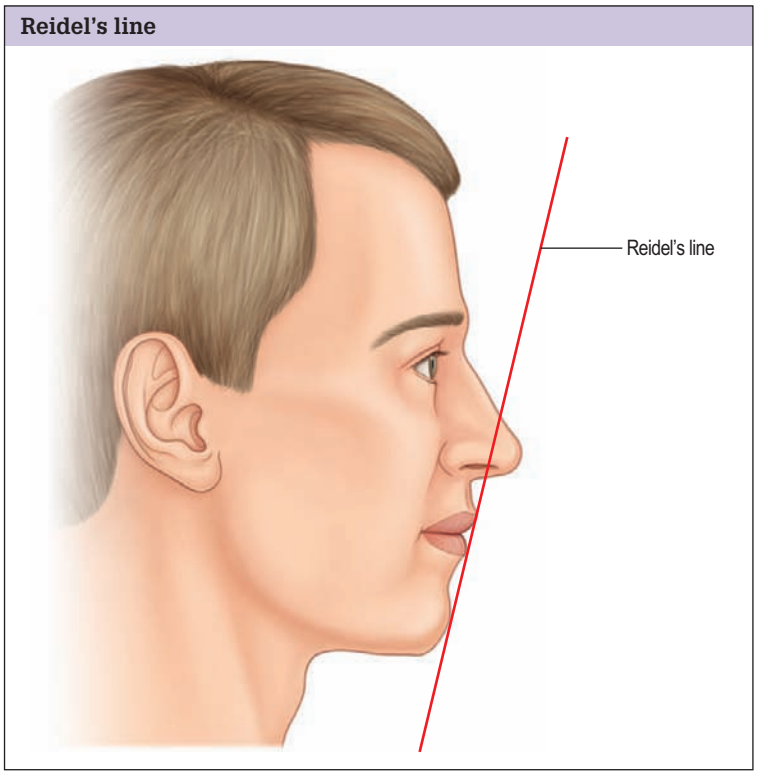


Fig. 13.12 Reidel's line. The most projecting portions of the upper lip, lower lip and chin are all tangent to this line when lower facial harmony is present.

Removal of a horizontal segment with setback of the remaining caudal segment is required for combined horizontal and vertical macrogenia (Fig. 13.15).

Group II deformities are comprised of microgenic chins. Augmentation genioplasty for mild or even moderate pure horizontal deficiency is discussed in a later section. A horizontal osteotomy with advancement of the caudal segment is a predictable method of treating horizontal chin deficiency (Fig. 13.16). Pure vertical chin deficiency is addressed with a horizontal osteotomy and caudal repositioning (Fig. 13.17). Combined vertical and horizontal microgenia is managed with repositioning the osteotomized chin segment caudally and anteriorly (Fig. 13.18). With any of these osteotomies, whenever caudal repositioning is performed and a gap greater than 5 mm results, interposition bone grafting or placement of a hydroxyapatite block is indicated. Smaller defects are within the osteoblastic filling (jumping) distance.

Patients with Group III chin deformities have osseous excess in one direction and deficiency in another. Combined horizontal excess with vertical deficiency is remedied with a horizontal osteotomy followed by caudal and posterior repositioning of the caudal segment (Fig. 13.19). When vertical excess is paired with horizontal deficiency, two osteotomies are performed to remove an anteriorly based wedge of bone. The caudal segment is then advanced cephalically and anteriorly and the gap is closed (Fig. 13.20).

Asymmetric chins are classified as Group IV. Patients with asymmetric chins are not ideal candidates for genioplasty with alloplasts. Asymmetric chins with normal lower facial height are treated by removing a wedge from the excessive side followed by autografting of that wedge on the side of deficiency (Fig. 13.21). If lower facial height is excessive, the caudal segment is repositioned cephalically and the wedge is discarded. If the face is vertically short only one osteotomy is performed and the caudal segment is differentially moved caudally and the resultant gap is grafted with a segment of bone.[25]

In the correction of deformities classified as I–IV, the magnitude of caudal bone segment repositioning is determined using the knowledge of the soft tissues responses to the skeletal alterations as outlined (Table 13.2).[8,26]

Group V patients have pseudomacrogenia, an excess of chin soft tissue that results in the appearance of chin excess. This diagnosis is facilitated by review of radiographic studies demonstrating excess chin soft tissue. This type of chin dysmorphology is corrected through a submental incision. Pseudomicrogenia resulting from vertical maxillary excess and clockwise rotation of the mandible constitutes the group VI chin deformity. This type of deformity requires orthognathic

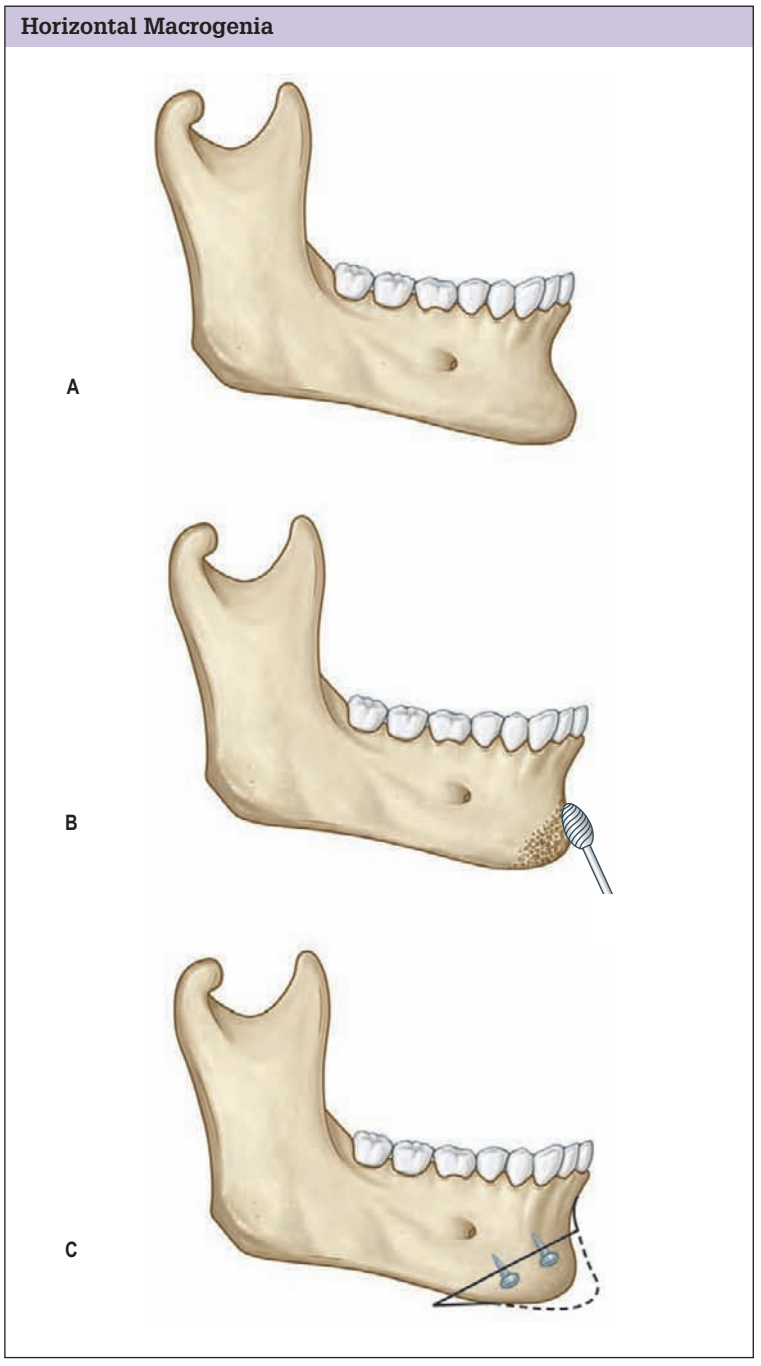


Fig. 13.13 Horizontal macrogenia. In the upper diagram the broken line represents the normal bone outline. The middle diagram demonstrates reduction ostectomy with burr. The lower diagram demonstrates two oblique ostiotomies with resection of the intervening segment and set back to the caudal segment. The shaded area represents contouring of steps-offs following set back with burr.

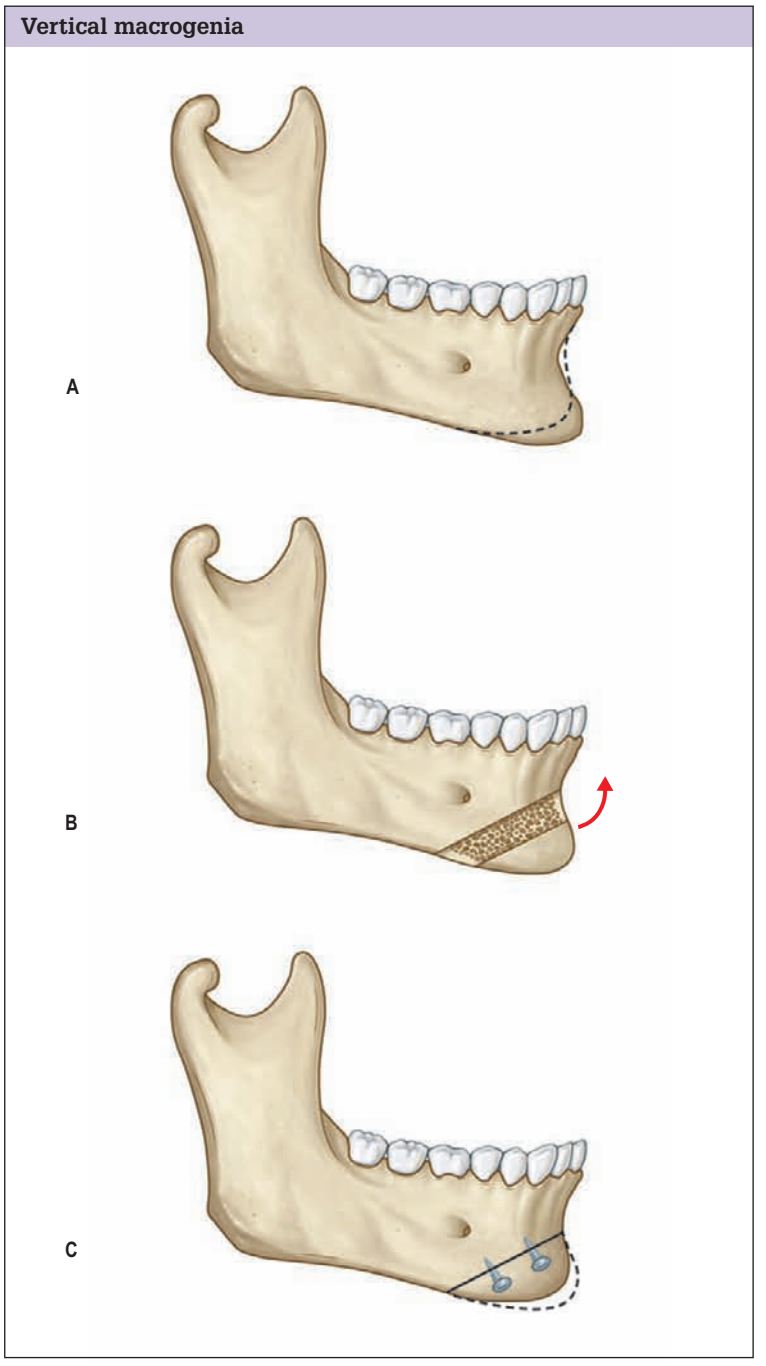


Fig. 13.14 Vertical macrogenia. The broken line demonstrates an almost horizontally oriented normal chin bone; the excess is almost purely vertical. The middle diagram demonstrates two ostetomies to shorten facial height. In the lower diagram the caudal segment is repositioned cephalically and fixed in place.

surgery. The group VII chin is the 'witch's chin' characterized by soft tissue ptosis, which is corrected by removal of excessive soft tissues through an elliptical incision in the submental area.

OPERATIVE APPROACH

Osseous genioplasty

Osseous genioplasty refers to alteration of the chin with modifications of the chin bone using two different methods that include ostectomy and osteotomy with caudal segment repositioning. Ostectomy is used exclusively for reduction genioplasty. This is indicated in patients with a chin that is excessive in the horizontal dimension, is long in the central portion only, or appears asymmetric due to excess bone on one side.

Reduction genioplasty by ostectomy is performed under local anesthesia and monitored sedation, or under general anesthesia. This procedure is indicated for mild horizontal or mild vertical macrogenia. The chin is infiltrated with xylocaine containing 1 : 100 000 epinephrine. Access is obtained through a 4 cm submental or an intraoral incision placed on the labial mucosal surface anterior to the sulcus. A 1 cm cuff of mucosa and mentalis muscle must be maintained on the gingival side of the incision to facilitate the repair. The periosteum is elevated off of the anterior surface of the mandibular symphysis. The mental foramina are visualized and the nerves are gently protected with malleable retractors.

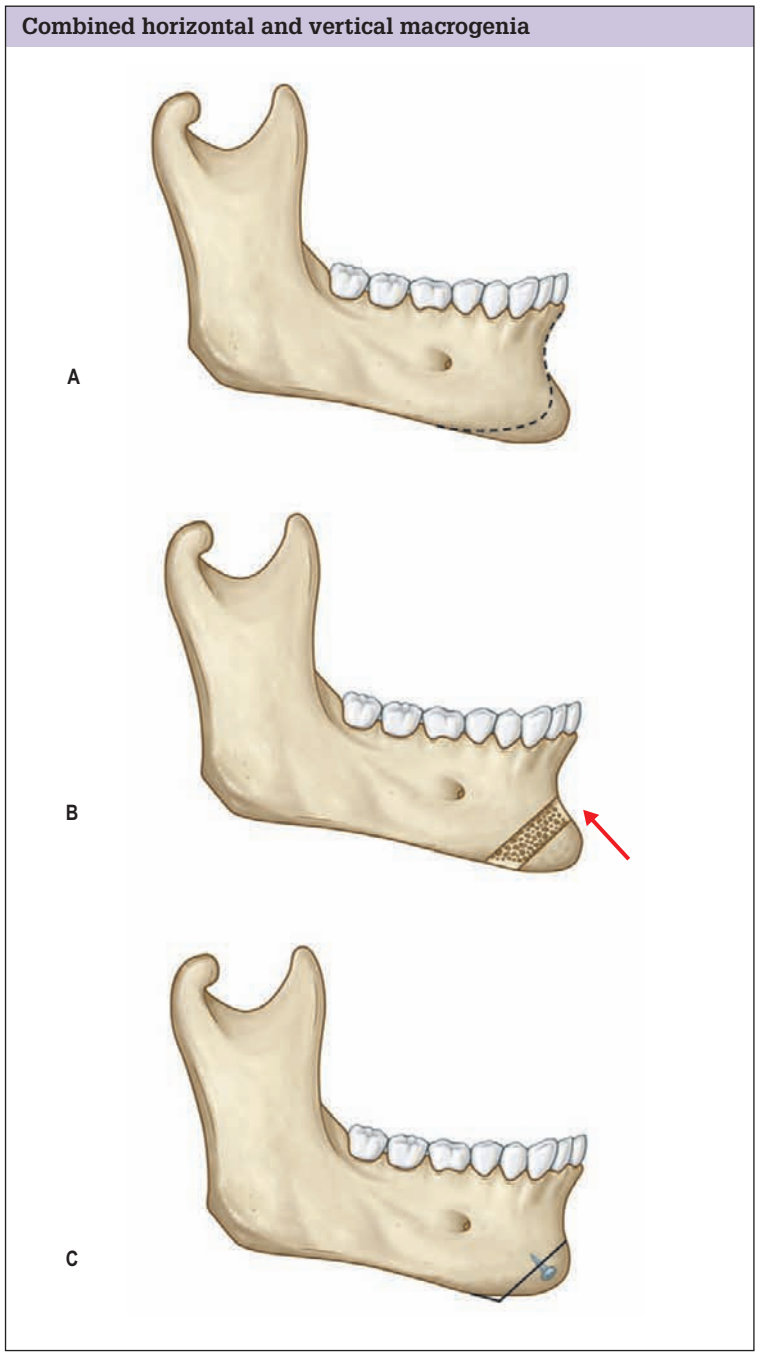


Fig. 13.15 Combined horizontal and vertical macrogenia. In the upper diagram the broken line demonstrates macrogenia in both the horizontal and vertical plane. The middle diagram demonstrates two obliquely oriented osteotomies to reduce the chin's horizontal and vertical dimensions. The lower diagram demonstrates the caudal segment positioned posteriorly and cephalically and fixed following removal of the intervening segment.

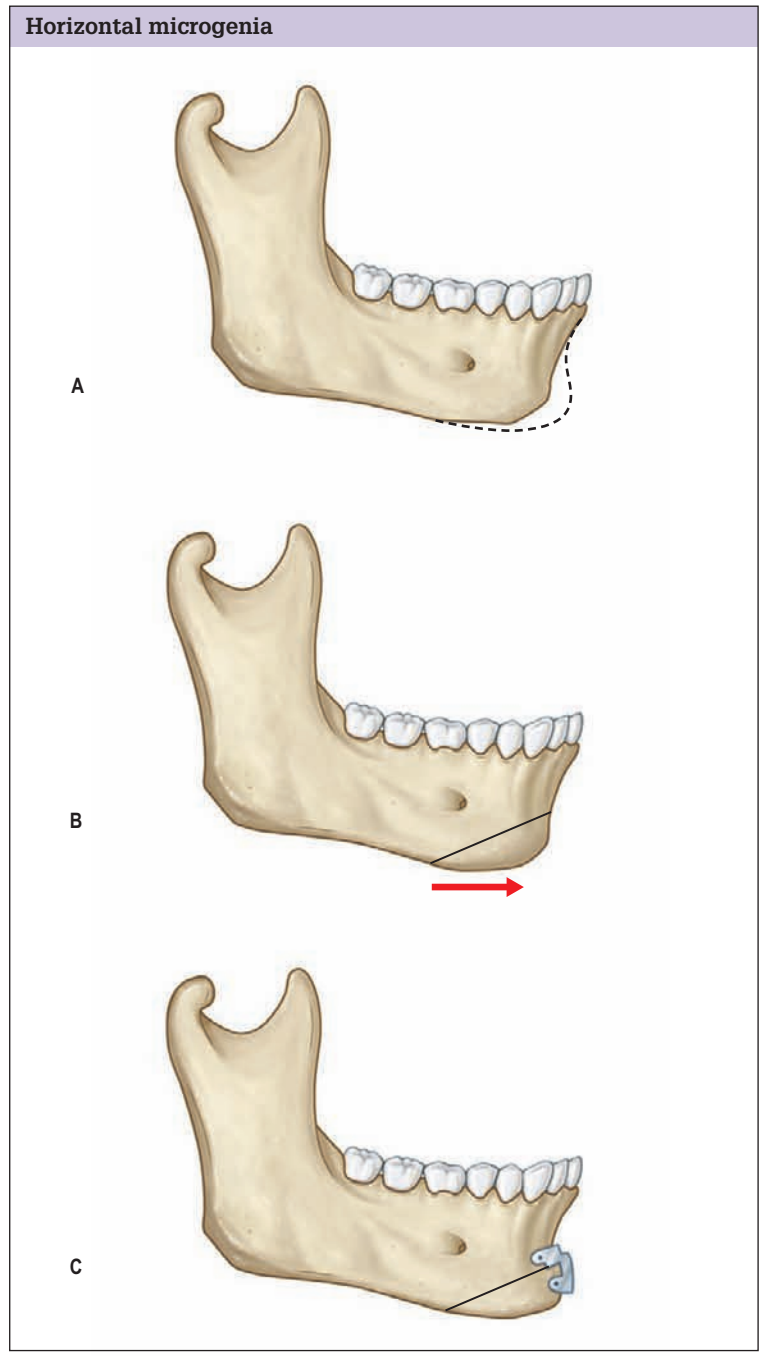


Fig. 13.16 Horizontal microgenia. The broken line in the upper diagram demonstrates the normal chin bone outline. In the middle diagram illustrates an oblique osteotomy. In the lower diagram the caudal segment is advanced and fixed in place.

An oval burr is used to incrementally remove bone from the anterior surface of the mandible on one half at a time (Figs 13.13 & 13.22). While the burr is being used, the first-generation bone is copiously irrigated with saline containing antibiotics (1 g of cephalosporins in 1 l saline) to avoid thermal damage. More bone is removed centrally and the ostectomy is tapered laterally and superiorly to the level of the mental foramen to prevent irregularities. A caliper is used to assess the amount of bone removed on the first half to have a precise account of how much bone is removed. If the bone is removed on both sides in continuum, it will be difficult to gauge the amount of removed bone precisely. After a sufficient amount of bone is removed on one side, the procedure is repeated on the opposite side.

Table 13.2 Soft tissue responses to augmentation or osseous adjustment

Osteotomy
Retraction: 0.9/1 to 1/1
Vertical reduction: 0.8/1 to 1/1
Advancement: 0.9/1 to 1/1
Burr osteotomy
Horizontal: 0.25/1 to 0.5/1
Vertical: 0.5/1 to 0.75/1
Augmentation: 0.8/1 to 1/1

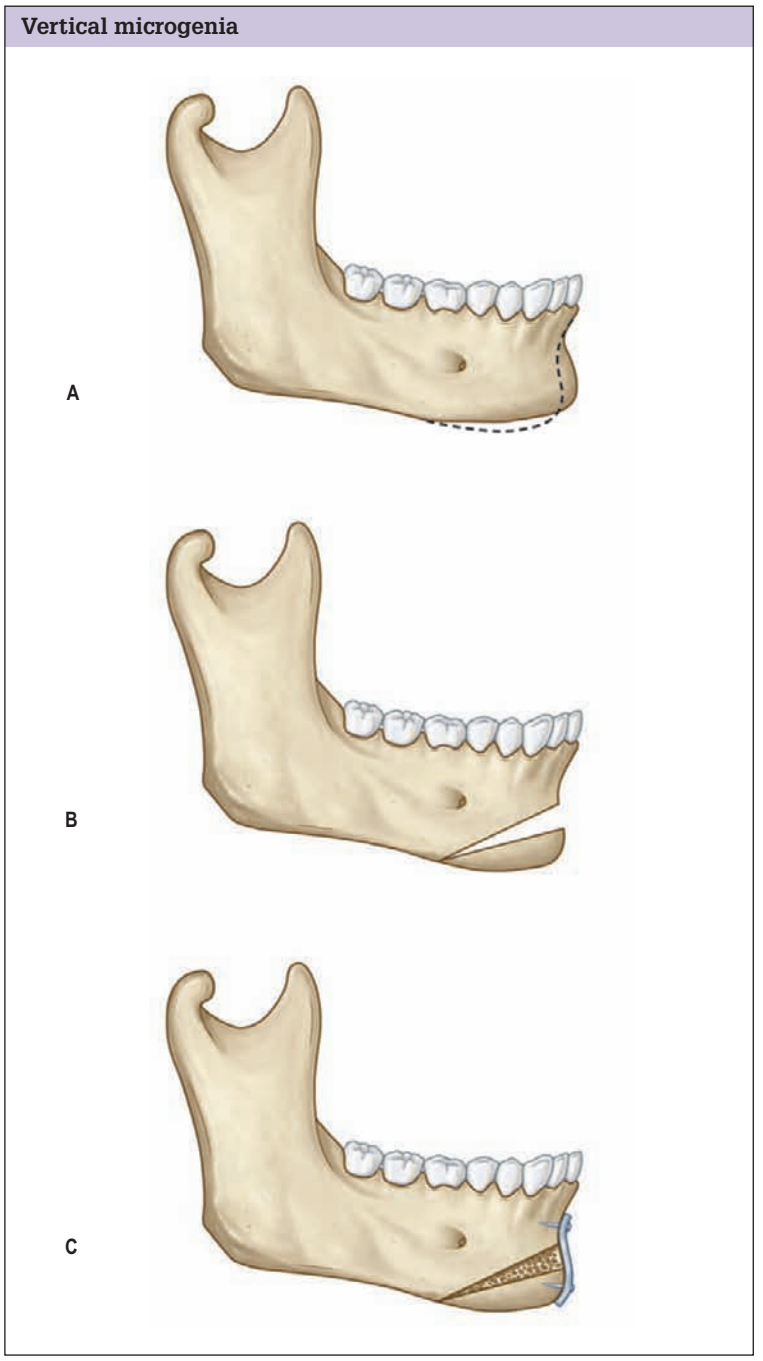


Fig. 13.17 Vertical microgenia. In the upper diagram the broken line demonstrates the normal chin bone outline. The middle diagram an oblique horizontal osteotomy is shown. The lower diagram demonstrates the inferior positioning of the caudal segment. Bone graft or hydroxyapatite is used to fill gaps greater than 5 mm.

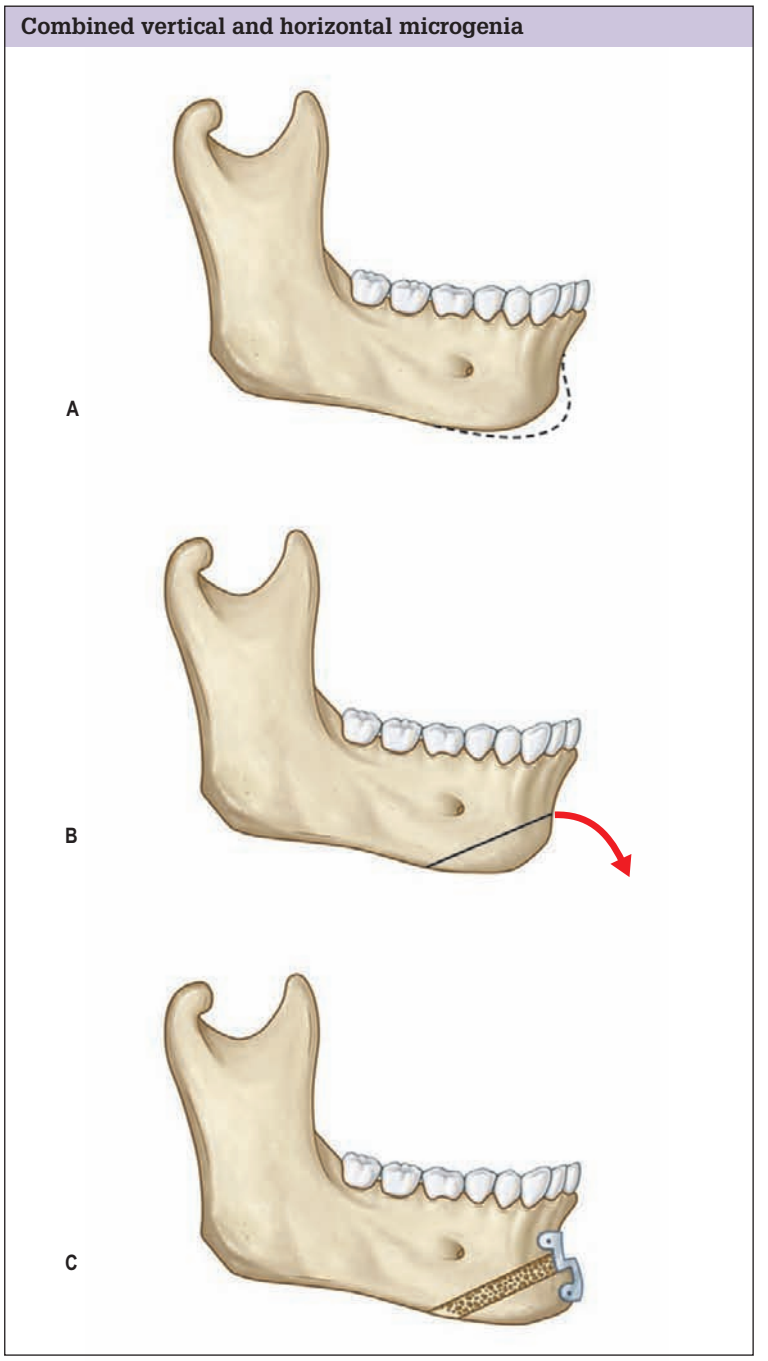


Fig. 13.18 Combined vertical and horizontal microgenia. In the upper diagram the broken line demonstrates the normal chin bone outline. The middle diagram demonstrates an oblique horizontal osteotomy. In the lower diagram the caudal segment is moved anteriorly and caudally. Bone graft or hydroxyapatite is placed in the gap.

Following visual and digital confirmation of smooth contours, the wound is irrigated with antibiotic containing solution. It is important to close the wound in such a way that the mentalis muscle is repaired at the level it was divided and the mucosa is well approximated using 4-0 chromic sutures. A compressive tape dressing or chin sling is placed.

Osteotomy with caudal segment repositioning

While under general or monitored anesthesia care, local blocks with 1% xylocaine containing 1 : 100 000 epinephrine are employed at the mental foramen and soft tissues over the lingual and labial surface of the mandibular symphysis are injected generously to decrease bleeding and postoperative pain (Figs 13.23 & 13.24). Exposure is achieved using the previously described intraoral approach (Figs 13.25–13.28). The inferior soft tissues are left intact to provide the blood supply to the caudal chin segment. Prior to performing an osteotomy, the midline is marked by etching a vertical line in the anterior cortical surface with a saw (Fig. 13.29).

Osteotomies are performed with minimal risk of injury to the teeth and the inferior alveolar nerve. The average length of the lower canine, the longest mandibular tooth, is 25.5 mm. The osteotomy should be performed 5 mm caudal to the projected canine roots, this equates to at least 30.5 mm inferior to the incisal edge. Furthermore, to avoid nerve injury the location of the osteotomy should also be 5 mm caudal to the mental foramen.

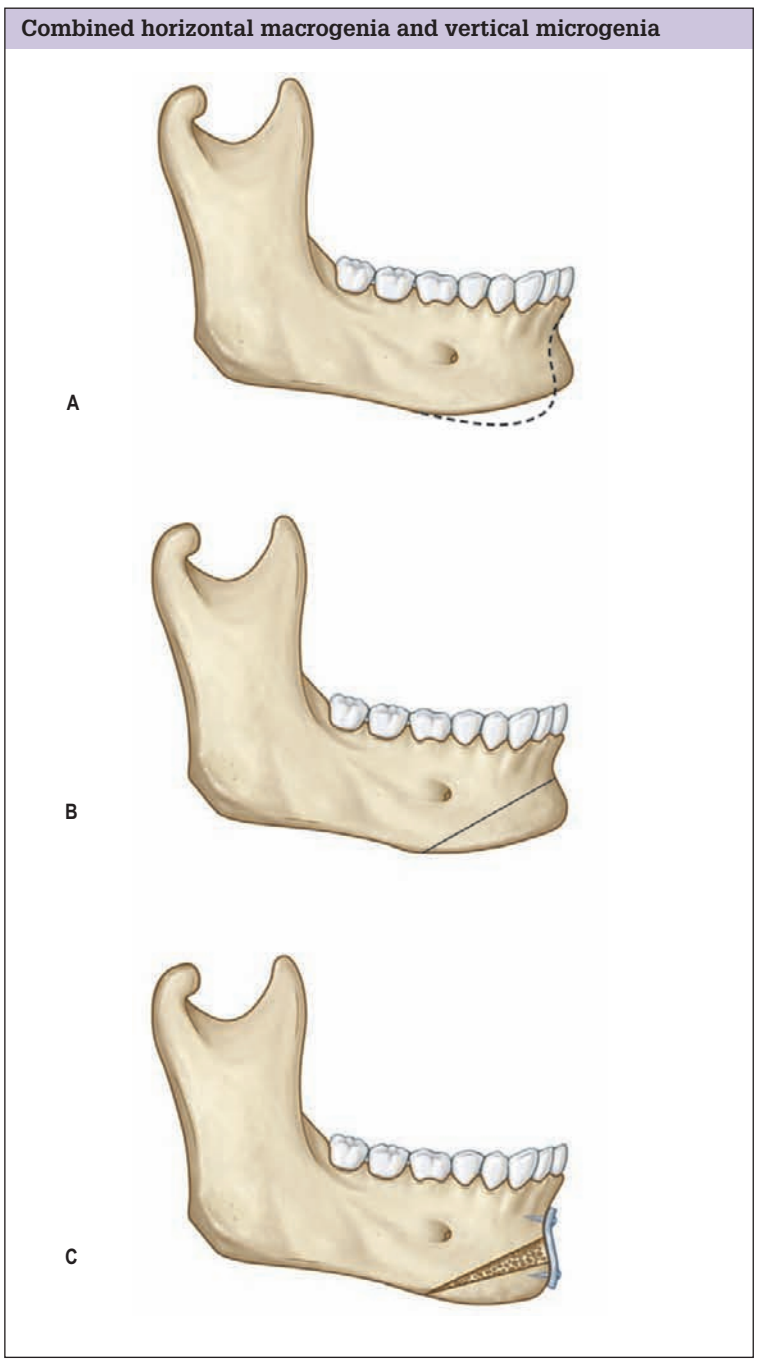


Fig. 13.19 Combined horizontal macrogenia and vertical microgenia. In the upper diagram the broken line outlines the normal chin bone profile. An oblique horizontal osteotomy is shown in the middle diagram. In the lower diagram the caudal segment is moved caudally and inferiorly. Bone graft is used depending on the size of the gap.

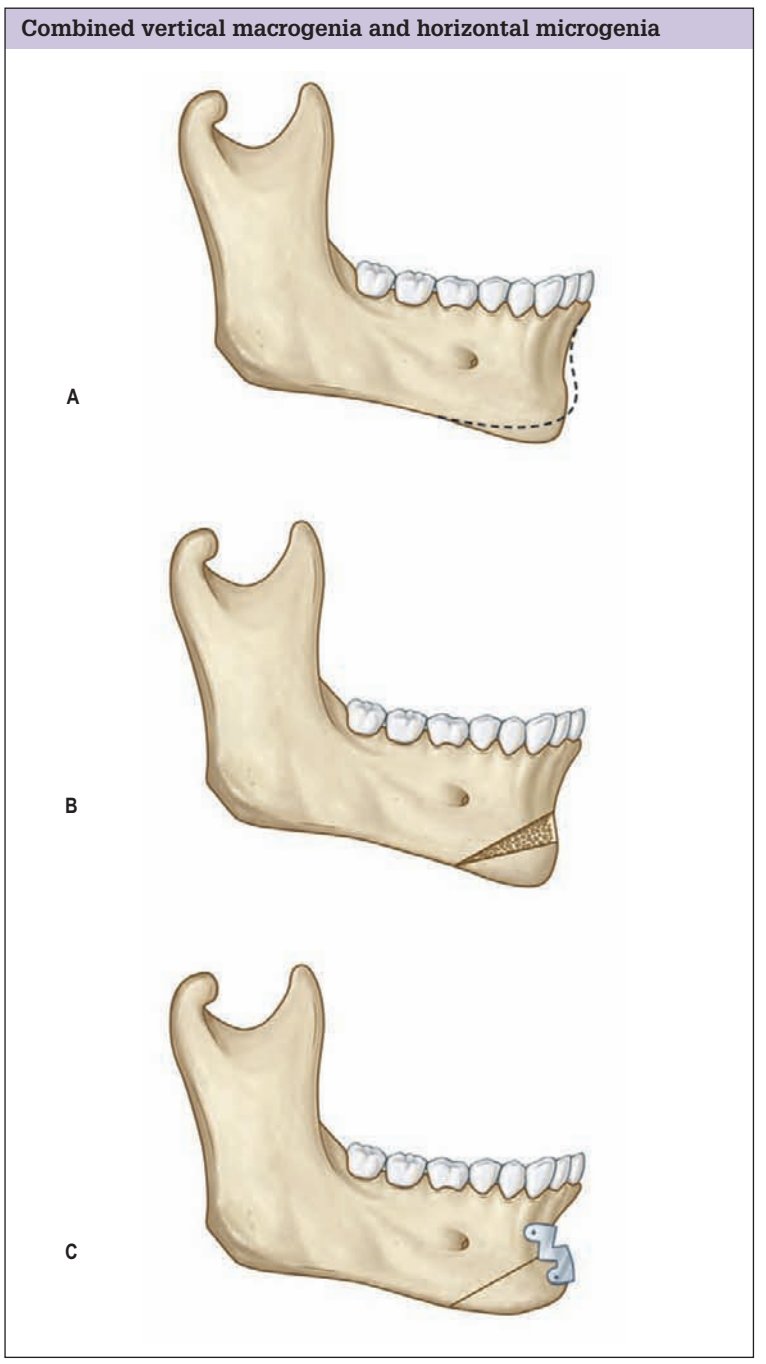


Fig. 13.20 Combined vertical macrogenia and horizontal microgenia. In the upper diagram the broken line illustrates normal chin bone outline. Two osteotomies with a wedge ostectomy are demonstrated in the middle diagram. The lower diagram demonstrates cephalic and anterior positioning of the caudal chin segement with fixation.

A wide saw blade is used to initiate the osteotomy in the central portion of the chin (Fig. 13.30). The saw blade is changed to a narrower one to complete the osteotomies laterally (Fig. 13.31). The osteotomy site is continuously irrigated during the course of the osteotomy. Malleable retractors protect the nerves and the other soft tissues throughout the osteotomy. After the caudal segment is freed it is advanced or retracted to the desired position (Fig. 13.32). A prefabricated step plate is contoured and placed in position to fit the anterior symphysial surface on both sides of the osteotomy (Fig. 13.33). Four screws, two on each side of the osteotomy, are placed (Fig. 13.34). Two osteotomies with removal of an intervening segment are used when a reduction in height is desired (Fig. 13.35). If setback is performed two screws should be sufficient for fixation after which a burr is used to the contour the lateral chin-mandible junctions bilaterally. The wound is then repaired as previously described (Fig. 13.36).

Genioplasty using augmentation techniques

In current parlance, augmentation genioplasty usually refers to the implantation of alloplastic implants. Autogenous augmentation using bone or cartilage grafts is highly successful. However, unless the graft material is readily available because of a concomitant procedure being performed, one has to forego autogenous augmentation in favor of an osteotomy, which is often simpler. In extreme craniofacial cases,

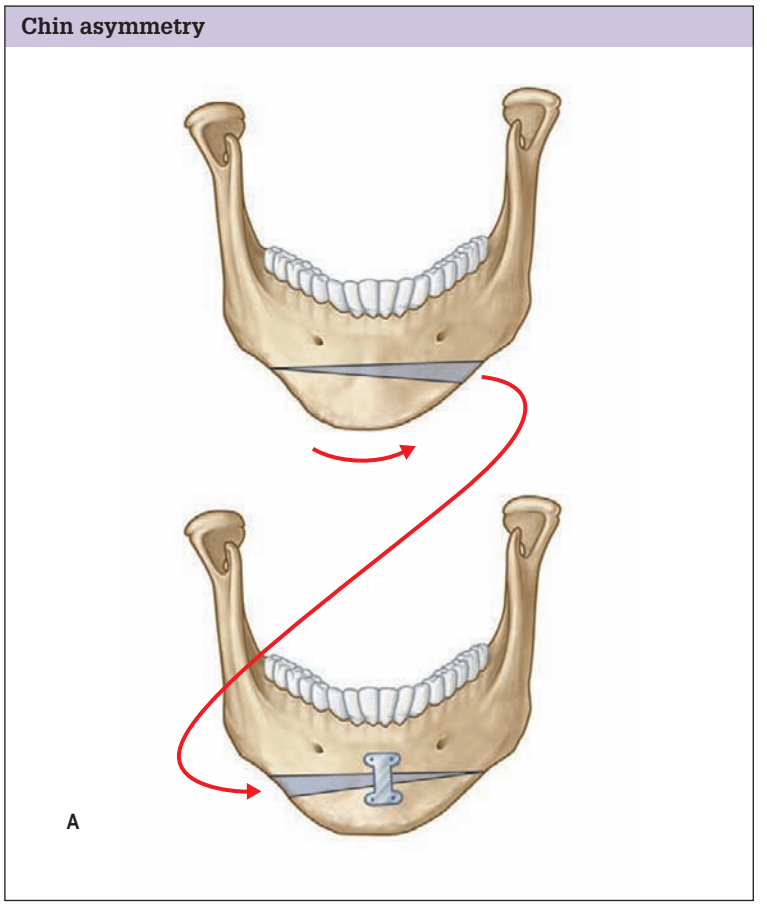


Fig. 13.21 Chin asymmetry. A, Chin asymmetry with normal anterior lower facial height. A segment is removed and reversed to obtain symmetry. B, An asymmetric chin with deficient overall anterior facial height. A horizontal osteotomy is made and differentially repositioned in a caudal direction. The resulting gap is grafted. C, Asymmetric chin with excess lower facial height. Two osteotomies are performed resulting in a wedge. The wedge is removed and the caudal segment is differentially positioned and fixed in a caudal direction to close the gap.

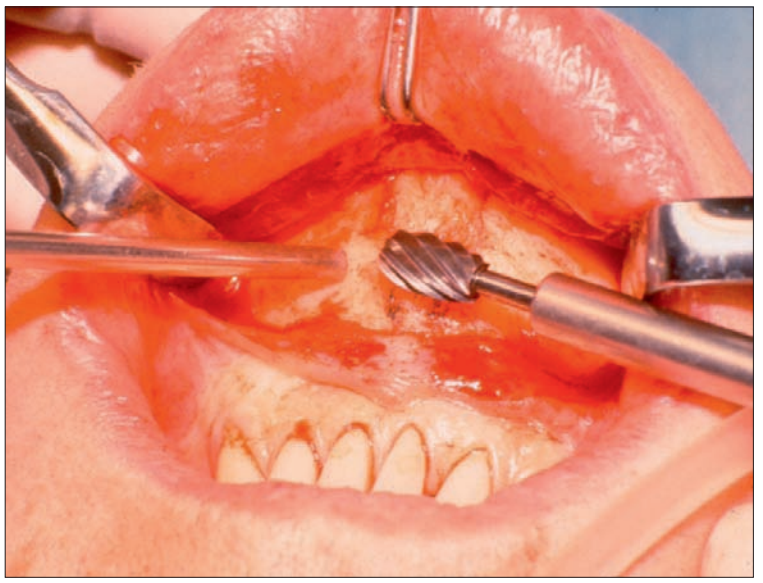


Fig. 13.22 Burr reduction genioplasty.

Fig. 13.24 Administration of local anesthesia to soft tissues posterior to mandibular symphysis.

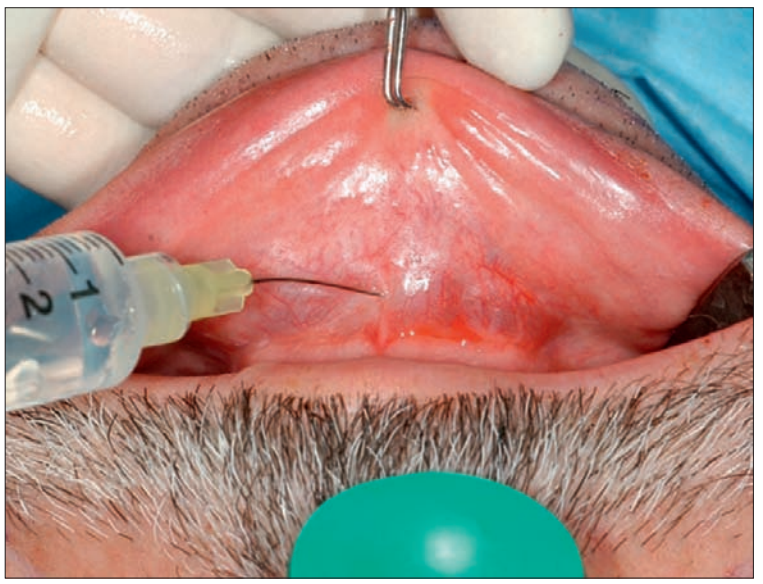


Fig. 13.23 Local injection of anesthesia and vasoconstricting agent in labial mucosa.

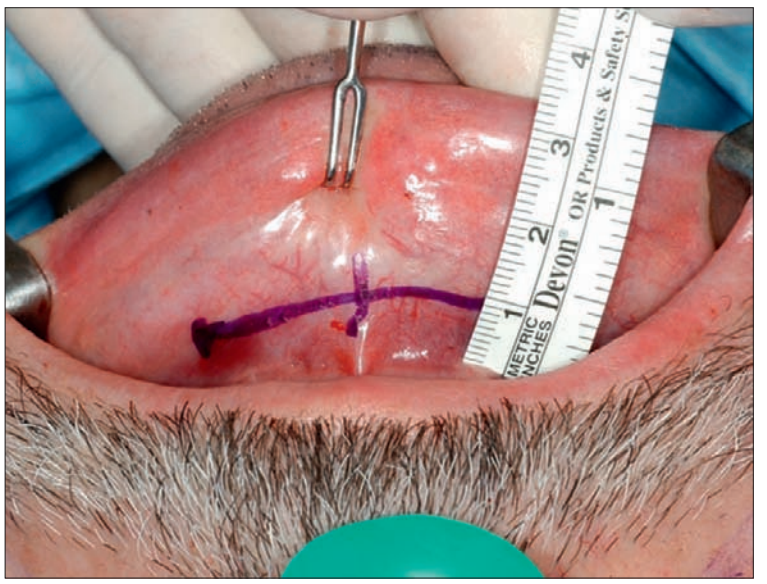


Fig. 13.25 The intraoral incision is marked 1 cm from the sulcus on the labial mucosa.

however, where the chin bone deficiency is too severe to reach the intended goals with an osteotomy, one may use bone or cartilage graft.

The two most common alloplastic materials used in augmentation genioplasty are silicone and porous polyethylene. While some literature suggests that silicone implants should be placed supraperiostially to diminish bone resorption, the senior author holds that a subperosteal plane should be considered for all implant types. Placing the implant in this plane and over the symphysis would minimize the soft tissue injury, dimpling and migration of the implant. Bone erosion will be also minimized if the implant is placed over the denser portion of the bone. Furthermore, if contracture should occur, the deeper location of the implant limits the deleterious affects on the soft tissue contour. The soft tissue response to augmentation genioplasty is 0.8 : 1.0 (Table 13.2).

Augmentation genioplasty can be performed under local anesthesia with sedation. A submental incision is favored over an intraoral approach because of the reduced risk of cephalad migration of the implant, dehiscence and infection. This incision also permits access to the anterior submental/cervical structures for lipectomy and platysma modification, which is commonly indicated in senescent patients requiring genioplasty.

The submental incision is placed 0.5 cm anterior to the natural submental crease. Prior to making an incision, the midline of the anterior chin is marked and extended across the incision. The area is infiltrated with xylocaine containing 1 : 200 000 epinephrine. The incision is made with a scalpel and carried through the soft tissues with electrocautery to the periosteum. The periosteum is incised and elevated. The midline mark on the skin is used to mark the underlying bone. A symmetric pocket is created just large enough to accommodate the implant using an Obwegeser elevator. The implant is inserted one side at a time and is positioned such that its midline is aligned with the midline of the chin as marked previously (Fig. 13.37). The wound is irrigated and the periosteum is closed using 5-0 monocryl for the periosteum and dermis and 6-0 fast-absorbable catgut for the skin. The soft tissue and skin are closed in layers. A tape dressing is applied. The patient will receive antibiotics perioperatively. An intraoral incision is employed when extended implants or mandibular angle implants are used. These are placed in the subperiosteal plane as well.

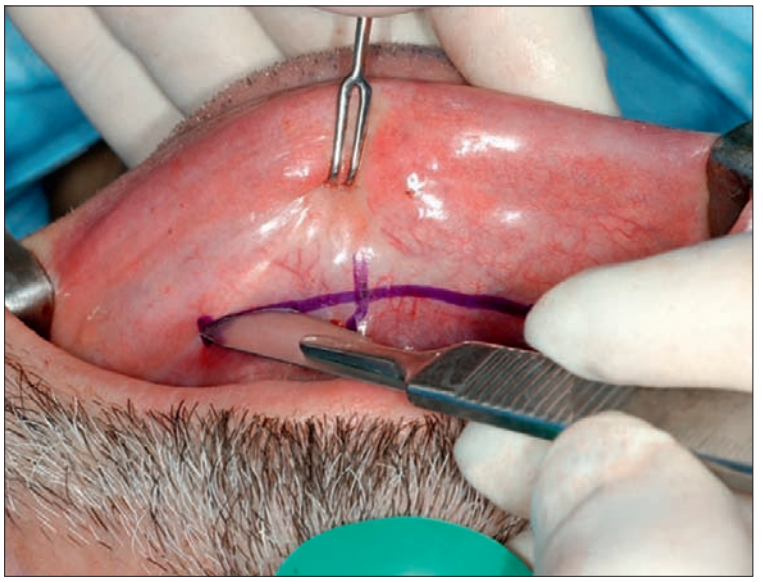


Fig. 13.26 A scalpel is used to make the initial incision.

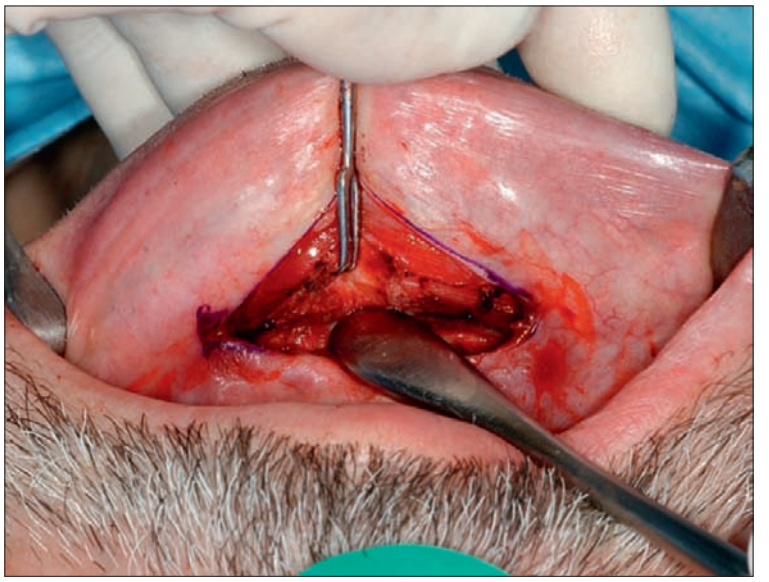


Fig. 13.28 A periosteal elevator is used to dissect in a subperiosteal plane taking care not to injure the mental nerves.

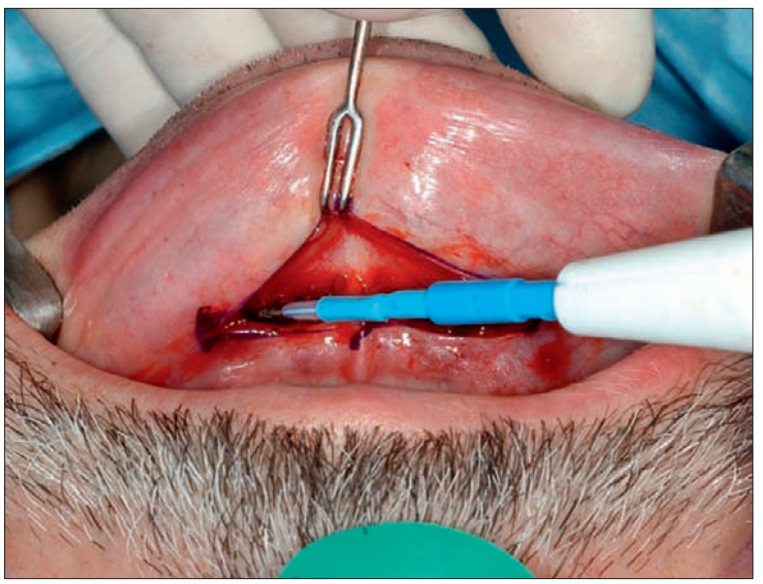


Fig. 13.27 Electrocautery is used to incise through the remaining soft tissues (mentalis muscle and periosteum) to reach the surface of the osseous chin. A cuff of mentalis muscle and mucosa is left on the cephalic aspect of the mandiblular symphysis to be used later for closure.

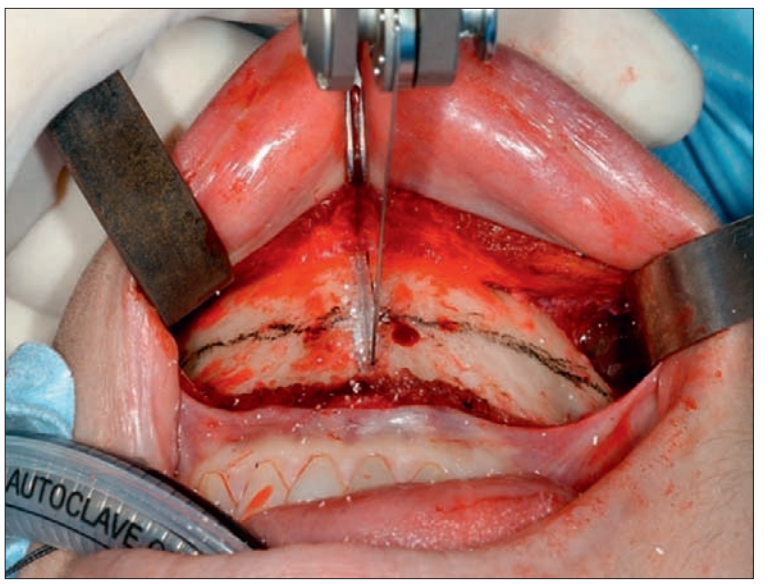


Fig. 13.29 A retractor is placed to retract the soft tissues and to protect the mental nerve. A vertical notch is placed to mark the midline of the symphysis to facilitate subsequent identification of midline and attainment of desired caudal segment alignment.

Optimizing outcomes

Outcomes are generally pleasing and improve chin appearance and overall facial harmony (Figs 13.38–13.41). Outcomes can be optimized as follows:

- Scrupulous preoperative evaluation: history, physical exam and soft-tissue cephalometric analysis of life-size photographs.
- Digital life-size photography to precisely plan the chin alterations.
- Utilization of osteotomy as often as possible to provide versatility to the technique and improve the cervico-mental angle.
- Leaving sufficient soft tissue on the gingival side of the incision to minimize lip ptosis and wound dehiscence.
- Placement of the implant in the subperiosteal plane when an implant is used.
- Protection of the soft tissue with malleable retractors to avoid nerve and soft tissue damage.
- Use of additional grafts under the labiomental groove, when an advancement over 10 mm is necessary, to avoid excessive deepening of in the labiomental groove.

COMPLICATIONS AND SIDE EFFECTS

Complications are rare. Nevertheless, the surgeon must understand their potential causes and management (Table 13.3).[27]

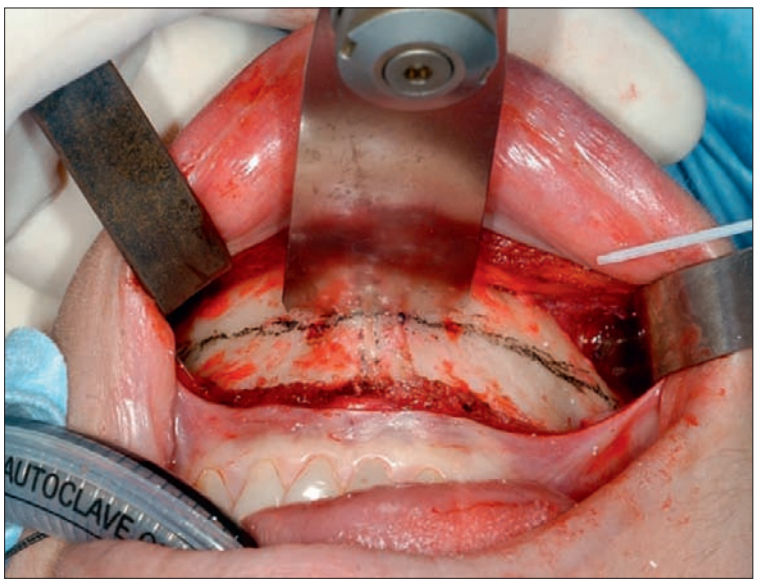


Fig. 13.30 A reciprocating saw with a wide blade is used to make the central component of the horizontal osteotomy.

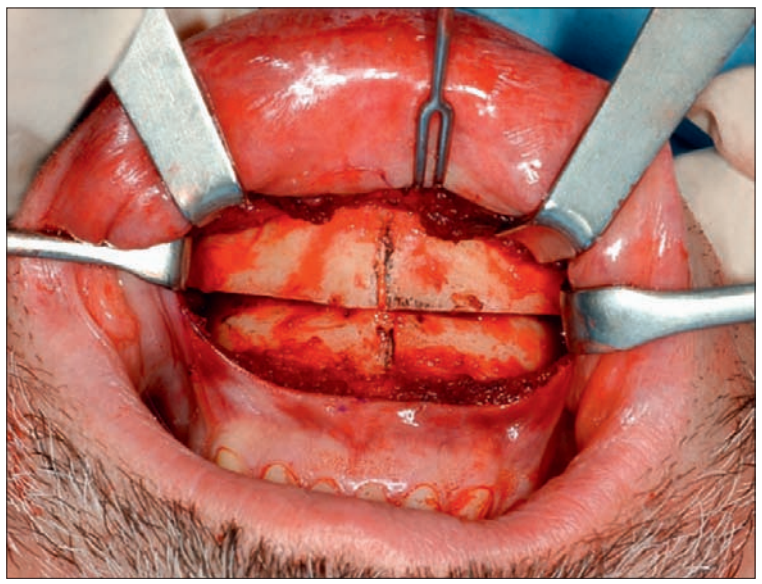


Fig. 13.32 The caudal segment is advanced.

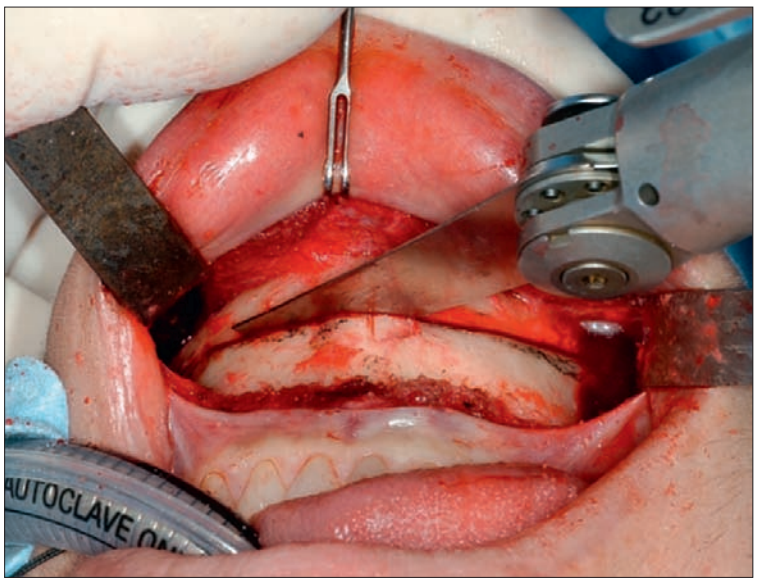


Fig. 13.31 The saw blade is changed to a narrower one to complete the lateral components of the osteotomy.

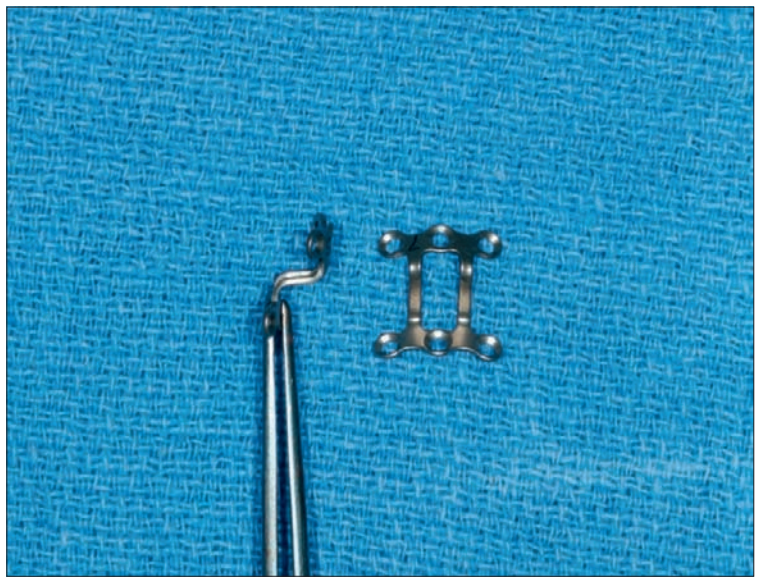


Fig. 13.33 The fixation plates have a step conformation to match the new contour of the anterior bone surface.

Complications of osseous genioplasty

Wound dehiscence and infection

Wound dehiscence and infection are rare after osseous genioplasty. As long as there is no loose or exposed hardware, most wound dehiscences will close spontaneously. Conservative debridement and irrigation, and intravenous followed by oral antibiotics are indicated. In most incidences, this regimen protects the osteotomy site and may avoid removal of the screws and plates.

Hematoma

Hematomas must be drained to prevent abscess formation, which will place the caudal bone segment in peril of resorption. Use of antibiotics will reduce the potential for an infection. This can be done under local anesthesia. The hematoma is evacuated and the wound is irrigated and repaired.

Tooth devitalization

Tooth devitalization is one of the most serious complications associated with genioplasty. All precautions must be enacted to obviate this complication. This includes placing the osteotomy at least 30.5 mm caudal to the occlusal edge of the mandibular canines.

Dental root exposure

This complication manifests itself as caudal retraction of the gingiva resulting in painful exposure of the sensitive portion of the teeth. This is usually the consequence of placement of the incision too close to the gingiva, although poor dental hygiene and infection can be the cause of this complication as well. Gingival grafting would be required to treat the associated pain and root exposure.

Neurosensory loss

Some degree of lip paresthesia occurs in more than one half of the patients treated with osteotomy of the chin bone. Sensory loss or reduction is often a temporary condition in almost all patients.[28] When numbness persists, it is generally characterized as hyposthesia, not anesthesia. When traction is the etiology, sensation generally returns within days to weeks. However, avulsion or transection injury during an osteotomy can occur if the osteotomy is too close to the mental

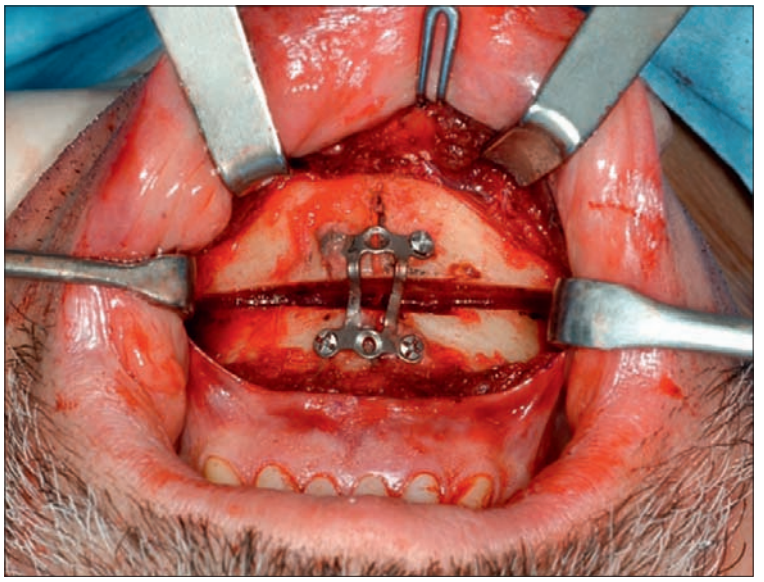


Fig. 13.34 The fixation plate is further contoured and fastened in place with four screws, two on either side of the osteotomy.

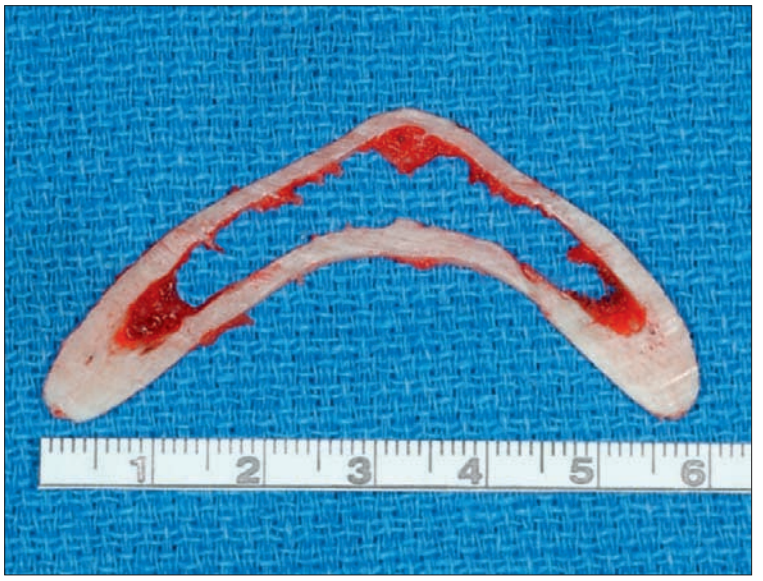


Fig. 13.35 A segment of bone can be removed to achieve reduction of anterior lower facial height.

foramen due to the fact that the nerve has a brief caudal course prior to emerging from the mental foramen (Fig. 13.6). Complete sensory loss with no recovery after 1 year may require exploration and neurorraphy.

Soft tissue ptosis

Soft tissue ptosis results in a displeasing chin form, a 'witch's chin', and is more common after reduction genioplasty. This complication is observed more frequently following chin ostectomy with burr rather than setback procedures. It can also occur following removal of a chin implant. Soft tissue excision through an elliptical incision in the submental area can correct this imperfection.

Asymmetry

Commonly, post-surgical asymmetry is the result of the failure to detect the pre-existing asymmetry, although the failure to correct unevenness or improper bone repositioning can also cause misalignment. Mild asymmetries can be managed expectantly as they may improve overtime with bone remodeling. Significant asymmetry should be corrected early, preferably prior to osseous union.

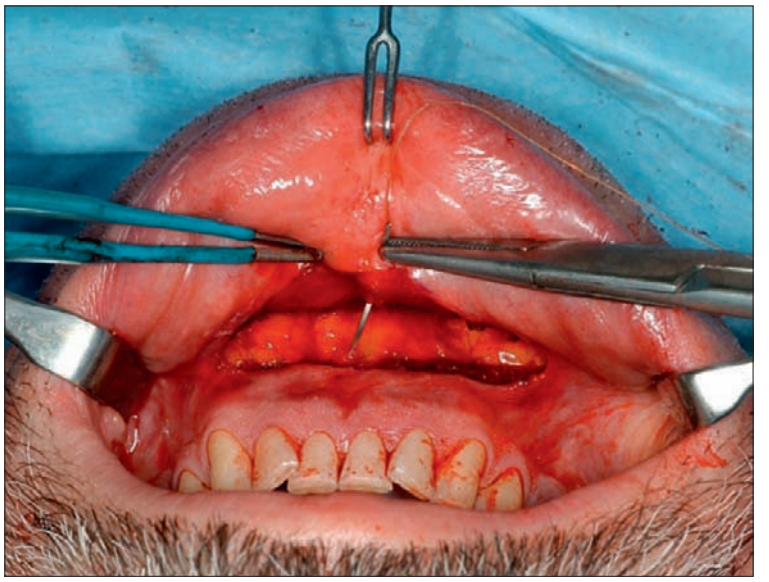


Fig. 13.36 The wound is closed carefully incorporating both mucosa and mentalis muscle in each suture bite in order to assure proper alignment. Multiple interrupted chromic gut sutures are used.

Overcorrection or undercorrection

Like asymmetry, overcorrection and undercorrection is the result of faulty surgical planning and/or imprecise surgical enactment. If in doubt, one should alter the chin conservatively. Either condition can be corrected through a revision osteotomy.

Irregularities and step-type deformities

A step-type deformity, if present, is most often seen along the posterior limits of the osteotomy. It is more common after a set-back technique when the mandibular border is not aligned perfectly. This should be noted and corrected by contouring the caudal segment. However, if such a flaw is discovered post-operatively, it should be observed for 6 months, during which time some bone remodeling may occur. If satisfactory improvement is not observed, an oval burr can be used to re-contour the mandibular border through a submental or an intraoral incision.

Lower lip retraction

Lower lip retraction is a manifestation of a loss of lower lip support. It results in descent of the lower lip position and an increase in lower incisor show. This complication is generally the consequence of incomplete or improper mentalis muscle repair.[29,30] This deformity can be corrected through an intra-oral incision, extensive subperiosteal dissection and suspension of the periosteum cephalically.

Complications of augmentation genioplasty

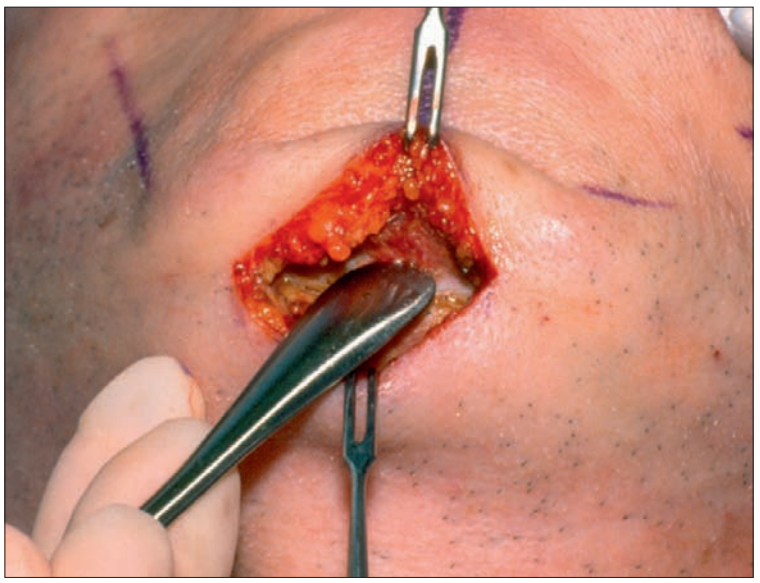
The first three complications of alloplastic chin augmentation, dehiscence, extrusion and infection are all potentially related to inadequate soft tissue closure and coverage following the use of intraoral incisions. The common error is placing the access incision too close to the sulcus and not leaving enough soft tissue over the gingival side.

Dehiscence

Dehiscence results in an exposed implant. One etiology is a tight pocket, which can also lead to wound tension and breakdown. The implant should be removed, the wound is irrigated and either loosely approximated or left to heal. Oral antibiotics are used for 5–7 days.

A

B



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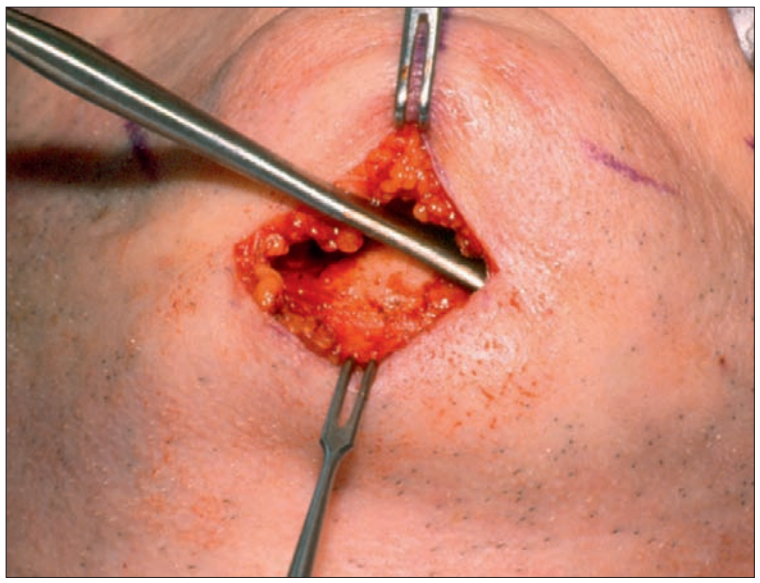

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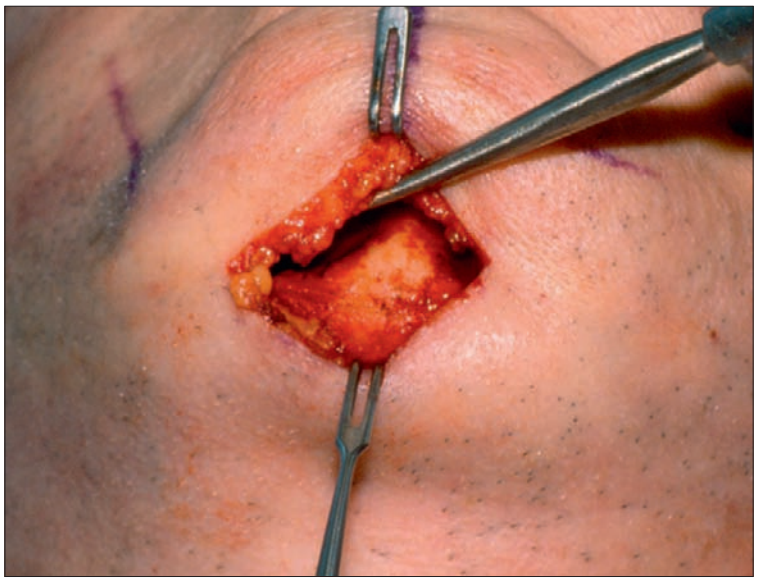

E

F

Fig. 13.37 Submental approach for augmentation genioplasty.

Fig. 13.38 A patient with horizontal microgenia before (left) and following advancement genioplasty, secondary rhinoplasty, and submental lipectomy (right) on front view (above) and profile (below).

Fig. 13.39 A patient with combined horizontal and vertical microgenia before (left) and following osseous genioplasty and submental lipectomy (right) on front view (above) and profile (below).

Table 13.3 Complications of genioplasty and their management

Complication	Management
Osteotomy	
Dehiscence and infection	Irrigation, debridement and closure of wound if hardware is stable, systemic antibiotics
Hematoma	Drainage
Tooth devitalization	Root canal by a dentist
Dental root exposure	Gingival grafting
Neurosensory loss	Conservative/expectant initially; neurorraphy if anesthesia persists
Soft tissue ptosis	Submental incision with skin excision
Asymmetry	Early re-operation prior to osseous healing
Overcorrection/undercorrection	Early re-operation prior to osseous healing
Irregularities and step-type deformities	Observe 6 months. If no improvement is noted recontour with oval burr
Lower lip retraction	Lip advancement
Augmentation	
Dehiscence/extrusion	Removal of implant, irrigation, closure, use of antibiotics
Infection	Explantation, irrigation, antibiotics and delayed osteoplastic genioplasty
Malposition	Re-operation with re-positioning
Bone resorption	Explantation and osteoplastic genioplasty if the impant is endangering the tooth root
Capsular contracture	Explantation and osteoplastic genioplasty
Lower lip retraction	Repair of mentalis muscle, lip advancement

Fig. 13.40 A patient with microgenia and aging face before (left) and following facial rejuvenation, submental lipectomy and osseous genioplasty (right) on front view (above) and profile (below).

Fig. 13.41 A patient before (left) and following reduction genioplasty with osteotomy (right) on front view (above) and profile (below).

Extrusion

Extrusion presents in a similar fashion as dehiscence, although dehiscence does not necessarily always expose the implant. When a chin implant is exposed, it is removed, the wound is irrigated and the wound edges are loosely approximated, and oral antibiotics are prescribed for 5–7 days. The residual or resultant deformity is best managed by osteoplastic genioplasty.

Infection

Infection involving chin implants in the absence of exposure is rare. When infection occurs, removal of the implant is usually inevitable. Delayed osseous genioplasty can often be performed with satisfactory results.

Malposition/dislodgment

Malposition is the placement of an implant in an inappropriate location. Re-operation with proper positioning or conversion to an osteotomy is indicated. Dislodgment refers to a change in location of the implant after correct initial placement. This occurs most often with silicone prostheses. Cephalic migration of an implant placed transorally is the most common presentation. Blunting of the labiomental groove is seen with this type of displacement. Removal of the implant and osseous genioplasty often provides the best outcome.

Bone resorption

Almost all augmentation genioplasties will result in some degree of bone resorption under the implant.[31,32] This complication is more common with non-porous implants such as silicone or acrylic. As resorption is essentially inevitable, care must be taken to place the implant caudally enough so that when bone erosion occurs, dental roots are not placed in peril. Additionally, the magnitude of resorption is less caudally due the higher bone density and decreased activity of the muscle overlying the implant. In case of pending erosion of the tooth roots, the implant should be removed and an osteotomy should be performed.

Capsular contracture

Capsule contracture is almost exclusively seen when a smooth implant is utilized, in particular silicone implants. This type of contracture distorts the implant and generates an unnatural soft tissue contours punctuated by a central bulge. Explantation, removal of the capsule

Table 13.4 Postoperative care

Short term
Liquid/soft diet initial – advances as tolerated following surgery
Compressive foam tape dressing – 2–3 days
Anti-septic mouthwash rinse (minimum: three times daily) – 5 days
Gentle tooth brushing labial surface mandibular teeth for 7 days
Oral antibiotics – 5–7 days
Resome heavy exercise – 21 days
Long term
Routine oral hygiene/prevention of periodontal disease
Avoidance of direct blunt trauma to chin

anteriorly, and osseous genioplasty are indicated; however, these interventions are not universally successful due to residual soft tissue distortion.

Lower lip retraction

Lip retraction presents with less frequency when submental access is used compared to the intra-oral incision. When it occurs, surgical elevation of the soft tissues with a subperiosteal dissection and cephalic fixation with bone tunneling or anchor suture may prove successful.[33]

POSTOPERATIVE CARE

The patient resumes eating the day of surgery. Liquids are advanced to a soft diet and then a regular diet according to the patient's general tolerance of food within 24–48 hours. The patient is instructed to rinse with antiseptic mouthwash after eating and three times daily. Tooth brushing can be resumed the day of surgery, but the patient should be instructed to exercise caution when cleaning the area close to the incision. Oral antibiotics are prescribed for 5–7 days. The patient should avoid heavy exercise for 3 weeks following osteotomy. Foam type compressive tape dressing is removed in 2–3 days (Table 13.4).

CONCLUSION

1. Precise closure of mentalis muscle and mucosa is important to avoid lip ptosis and wound dehiscence when intraoral incisions are used.
2. Augmentation genioplasty performed through a submental incision is prone to fewer complications than through an intraoral incision.
3. Exposure and judicious protection of the mental nerves can reduce the incidence of lip anesthesia.
4. Chin advancement should be done conservatively on patients with a long face deformity who decline orthognathic surgery.
5. When a set back genioplasty is performed, the posterior portion of the repositioned segment may require contouring to prevent palpable step deformities.

Genioplasty is a relatively straightforward procedure with low morbidity and highly gratifying results. The use of digital life-size photographs with soft tissue cephalometrics facilitates precise surgical planning and execution. Understanding of the nature of the deformity and proper selection of the procedure are the keys to a successful outcome. Genioplasty also plays a pivotal role in achieving superior results when other disharmonies are being addressed with rhinoplasty, submental lipectomy or facial rejuvenation.

Pitfalls

1. Use of a chin implant will not alter the cervico-mental angle as much as an osseous genioplasty.
2. Placement of the implant above the periosteum may cause dimpling of the skin.
3. Genioplasty alone will fail to provide a satisfactory outcome on patients with significant class II or III maxillary/mandibular deformity.
4. Alloplastic genioplasty will not correct the pre-existing chin asymmetry.
5. Significant chin advancement without augmentation of the B point may result in a deep labiomental crease, which can be very displeasing.

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CHAPTER 14

Aesthetic Contouring of the Craniofacial Skeleton

Michael J Yaremchuk

Summary

1. Most aesthetic augmentation of the facial skeleton is done with alloplastic implants.
2. Implant surgery can mimic the appearance obtained after skeletal osteotomies.
3. Solid silicone and porous polyethylene are the most commonly used materials for facial skeletal augmentation.
4. Incisions should be placed remote from implant placement.
5. The subperiosteal plane is preferred for implant placement.
6. Avoid large implants with poor transitions.
7. Gaps between the implant and the skeleton result in unanticipated increases in augmentation.
8. Screw fixation of the implant eliminates gaps between the implant and the skeleton as long as the implant is malleable.
9. Screw fixation of the implant prevents implant movement.
10. All faces are asymmetric. Facial asymmetries should be identified and discussed with the patients preoperatively.

INTRODUCTION

Augmentation is the predominant means of aesthetic contouring of the facial skeleton in non-Asian populations. Conceptually, autogenous bone would be the best material for augmentation, because it has the potential to be revascularized and, then, incorporated into the facial skeleton. In time, it could be biologically indistinguishable from the adjacent native skeleton. Practically, the use of autogenous bone is limited. The morbidity, time and hospital costs associated with autogenous bone graft harvest can be significant. Furthermore, the inevitable resorption and the poor handling characteristics of autogenous bone grafts also limit the quality and predictability of the aesthetic result. For these reasons, almost all facial skeletal augmentation is done with alloplastic implants. A diagrammatic survey of the facial skeletal areas amenable to augmentation with alloplastic implants is presented in Fig. 14.1.

INDICATIONS

- Facial skeletal augmentation is most often done to enhance facial appearance in patients whose skeletal relationships are ostensibly within the normal range. These patients want more definition and angularity to their appearance. Other patients desire to "balance" their facial dimensions.
- Craniofacial deformities which are disfiguring and are of functional consequence to vision, breathing, and mastication, usually require skeletal osteotomies and rearrangement as treatment. In patients with less severe midface or mandibular hypoplasia, occlusion is normal or has been compensated by orthodontics. These patients have neither respiratory nor ocular compromise. In these patients, the appearance of skeletal osteotomies and rearrangements can be simulated through the use of facial implants. Diagrammatic representations of how implant surgery can mimic the appearance of skeletal osteotomies are shown in Figs 14.2 and 14.3.

PREOPERATIVE EVALUATION

Physical examination

Physical examination is the most important element of preoperative assessment and planning. Reviewing life-size photographs with the patient can be helpful when discussing aesthetic concerns and goals. It also allows demonstration of the asymmetries common to all faces. Their recognition preoperatively is important to the surgeon in planning and to the patient in anticipating the postoperative result.

As asymmetries become more obvious, it is important to recognize that they are more complex than relative skeletal deficiencies or excesses. Rather, they reflect three-dimensional differences that are most easily conceptualized as twists of the facial skeleton.

Facial asymmetries should be identified on patients who seek facial augmentation and notified during the preoperative evaluation.

Radiology

Most aesthetic procedures are done without preoperative radiology assessment. In general, the size and position of the implant are largely aesthetic judgments. Cephalometric X-rays are most often used for planning chin and mandible augmentation surgery. These studies define skeletal dimensions and asymmetries as well as the thickness of the chin pad. Computerized tomographic (CT) scans provide the ability to view the skeleton in different planes and, through computer manipulation, in three dimensions. CT imaging provides digitized information that can be transferred to design software. This can be used to create life-sized models and custom implants, which are

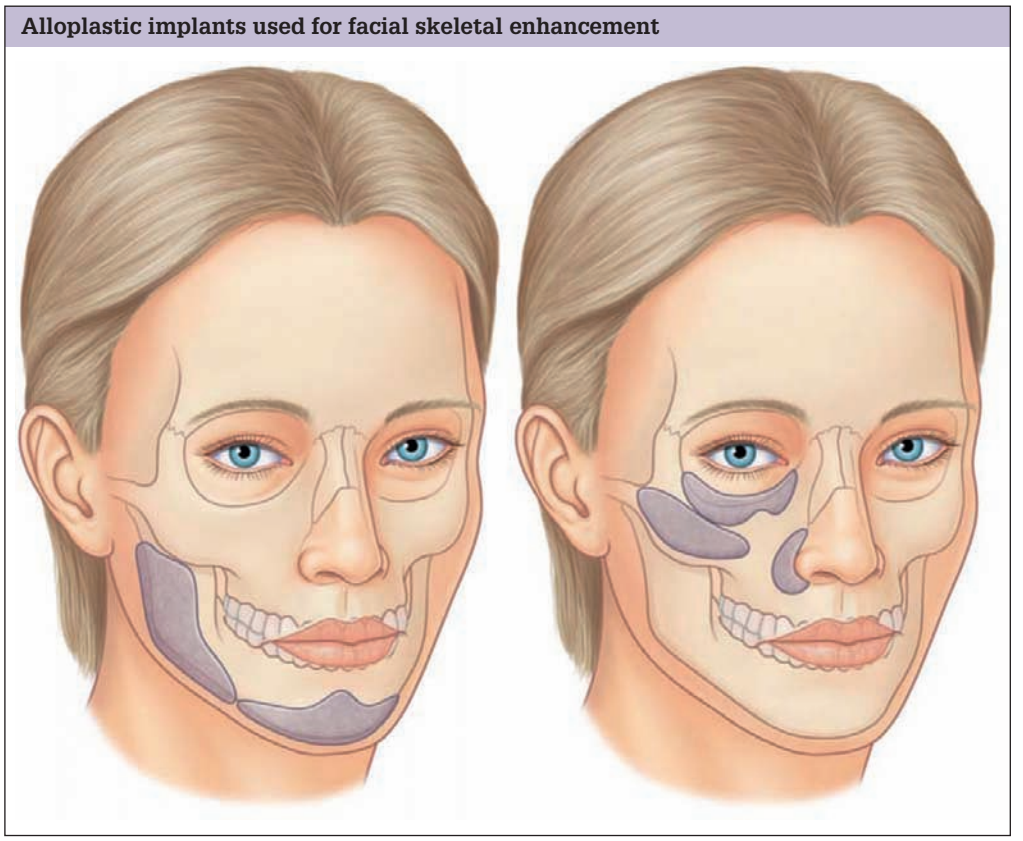


Fig. 14.1 A diagrammatic survey of the alloplastic implants used for facial skeletal enhancement. Anatomic areas include the infraorbital rim, malar, pyriform aperture, chin as well as the mandibular body and ramus.

particularly helpful when augmenting facial skeletons with significant asymmetries.

SURGICAL PLANNING

For most reconstructive problems, surgery is performed to return the involved area to its original appearance, or, if that is not possible, to one that is symmetric and accepted as normal. When alloplastic implants are used to make the face more attractive, the aesthetic goal is more arbitrary. Because implant augmentation of the facial skeleton results in measurable changes in facial dimensions and proportions, it is intuitively advisable and appropriate to use facial measurements to evaluate the face and to guide surgery.

Facial anthropometries and neoclassical canons

For purposes of painting and sculpture, Renaissance scholars and artists formulated ideal proportions and relations of the head and face. These were largely based on classical Greek canons. Although usually referenced in texts discussing facial skeletal augmentation, neoclassical canons have a limited role in surgical evaluation and planning, because they are based on idealizations. When the dimensions of normal males and females were evaluated and compared to these artistic ideals, it was found that some theoretic proportions are never found, and others are one of many variations found in healthy normals, or those determined more attractive than normals.[1,2] The neoclassical canons do not allow for the facial dimensions that are known to differ with sex and age. Most of these canons of proportion (e.g. the width of the upper face is equal to five eye widths), are interesting but hold for few individuals and cannot be obtained surgically or, if obtainable, only with extremely sophisticated craniofacial procedures. For these reasons, we have found it more useful to use the anthropometric measurements of normal individuals to guide our *Gestalt* in the selection of implants for facial skeletal augmentation (Fig. 14.4).[3] Normal dimensioned faces are intrinsically balanced. That is, the relations between the various areas of the face relate to one another in a way that is not distracting to the observer. By comparing a patient's dimensions to the average, the surgeon has some objective basis as to what anatomic area may be amenable to augmentation, and by how much.

Anesthesia and preparation

Facial skeletal augmentation can be performed under local anesthesia with sedation or general anesthesia. It is routinely performed on an outpatient basis. When implants are placed through intrasoral approaches, general anesthesia with nasotracheal or endotracheal intubation assures protection of the airway and the best possible antiseptic preparation of the oral cavity. Patient positioning and exposure for implant placement are also optimized when the airway is controlled. Prior to preparation and draping a dilute solution of Marcaine with epinephrine is infiltrated into the operative site for postoperative pain control and intaoperative hemostasis. Cephalosporins are administered perioperatively.

Incisions

Incisions are borrowed from craniofacial and aesthetic surgery.

Coronal incisions are used to place implants in the frontal and temporal areas. Transconjunctival retroseptal incisions are used to access the infraorbital rim and internal orbit. The lateral extent of the lower-lid blepharoplasty incision provides access to the lateral orbit and zygomatic arch. This small cutaneous incision leaves an inconspicuous scar. (I avoid skin or skin muscle-flap lower-lid approaches which not uncommonly heal with lower-lid malposition.) Intraoral sulcus incisions are used to augment the midface as well as the mandibular body and ramus. These incisions are made with a generous labial cuff to allow watertight mucosal closure. Chin area augmentation is performed through submental incisions. Placement of incisions directly over implants is avoided.

Multiple implant augmentation of the midface skeleton

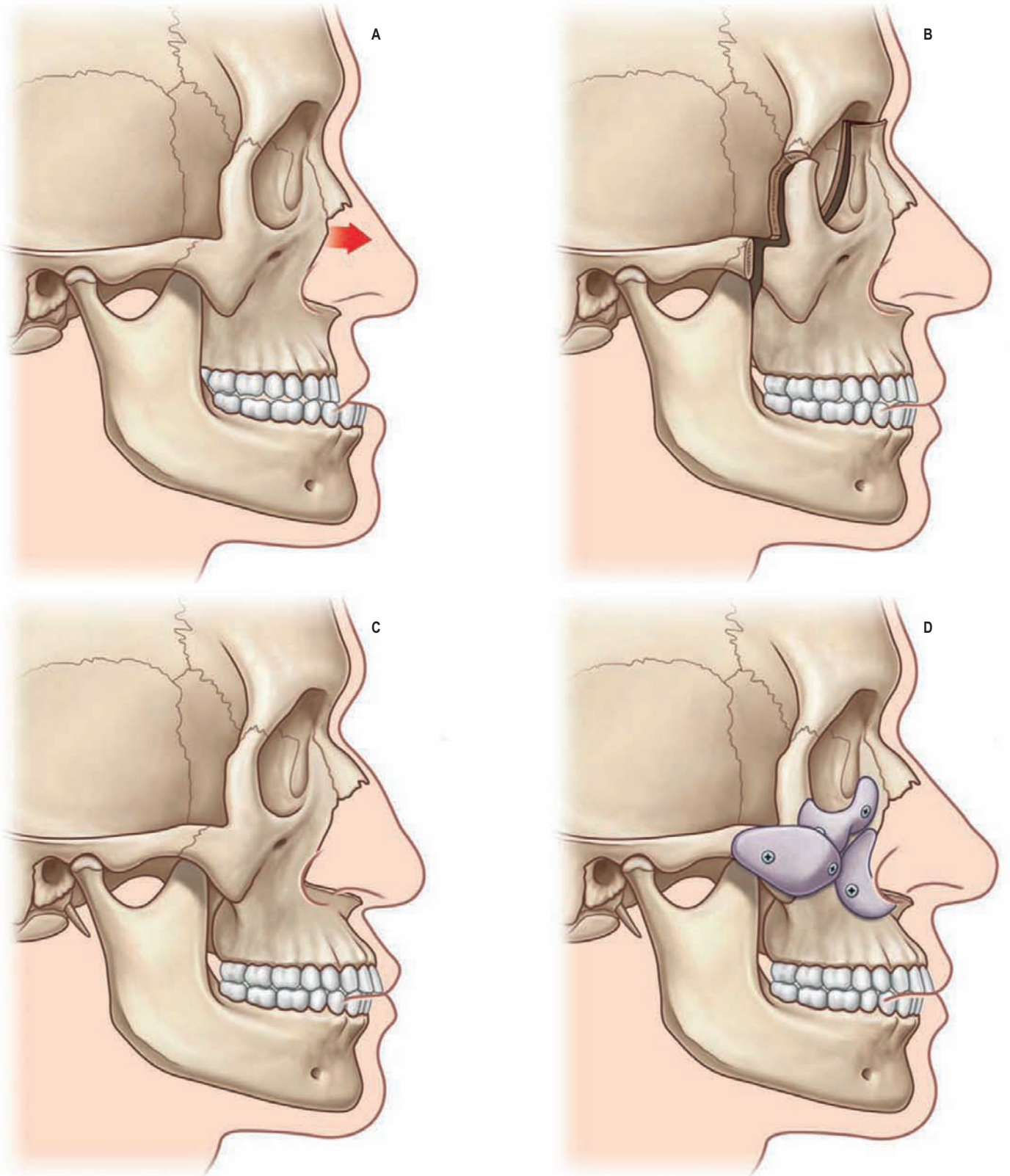


Fig. 14.2 Diagrams show how multiple implant augmentation of the midface skeleton can simulate the visual appearance of LeFort III osteotomy and advancement without altering dental occlusion. A, Illustration of midface concavity and Class III malocclusion. B, Osteotomy and advancement at the LeFort III level provides midface projection and Class I occlusion. C, Illustration of midface concavity and Class I occlusion. D, Multiple midface implants provide visual effect of LeFort III osteotomy and advancement but does not alter occlusion.

Multiple implant augmentation of the mandible

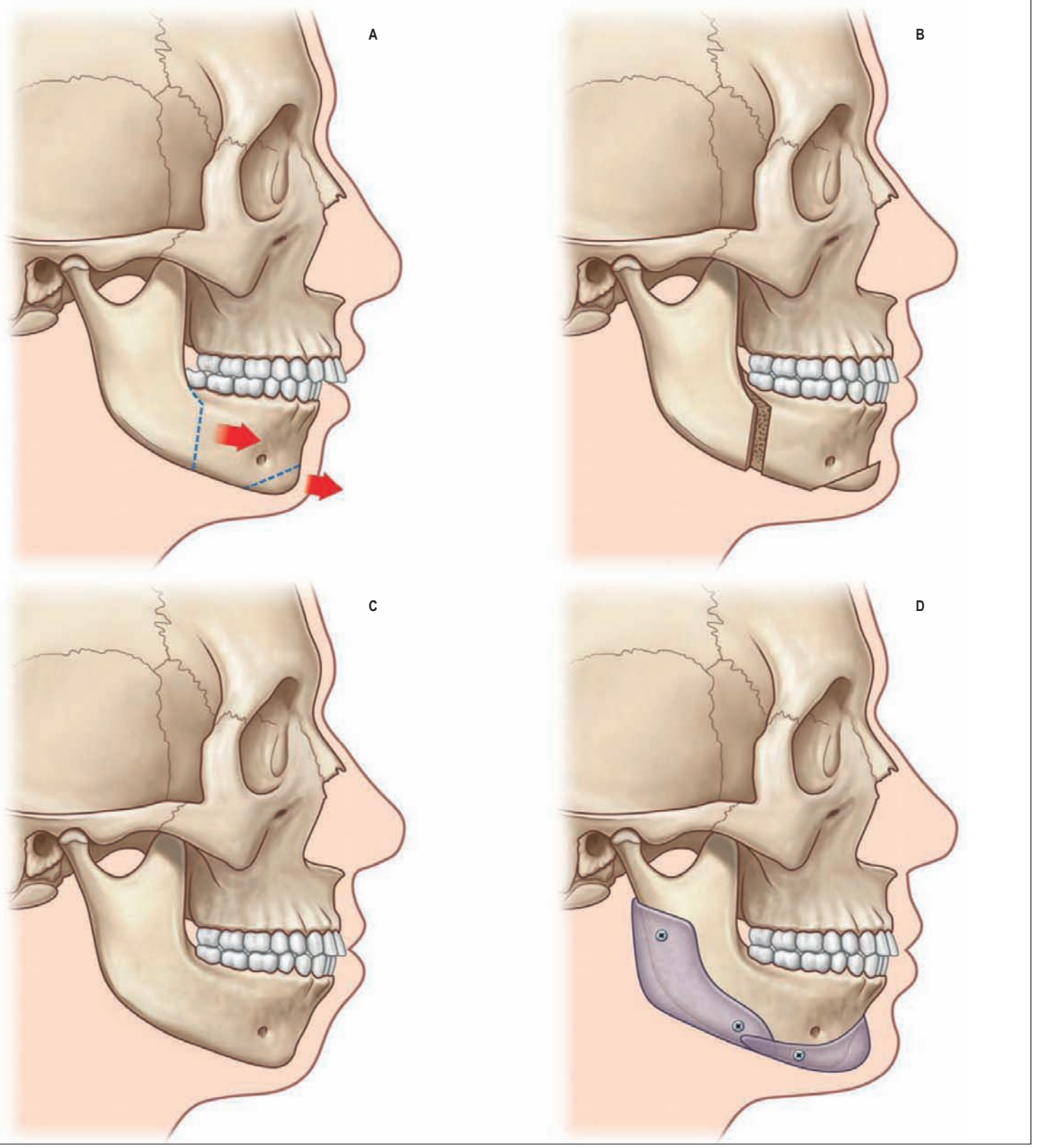


Fig. 14.3 Diagrams show how multiple implant augmentation of the mandible can simulate the visual appearance of of sagittal split osteotomy and horizontal osteotomy of the chin without altering dental occlusion. A, Mandibular deficiency with Class II occlusion. B, After sagittal split osteotomy with horizontal osteotomy and advancement of the chin to increase chin projection. Note that the occlusion has been corrected from Class II to Class I. C, Mandibular deficiency with Class I occlusion. D, The visual effect of sagittal split osteotomy and horizontal osteotomy of the chin with advancement has been simulated with mandible and chin implants. Note that the Class I occlusion is unchanged. Notice also that the border regularities inherent with skeletal osteotomies are avoided when implants are used.

Frontal and lateral views of female and male faces

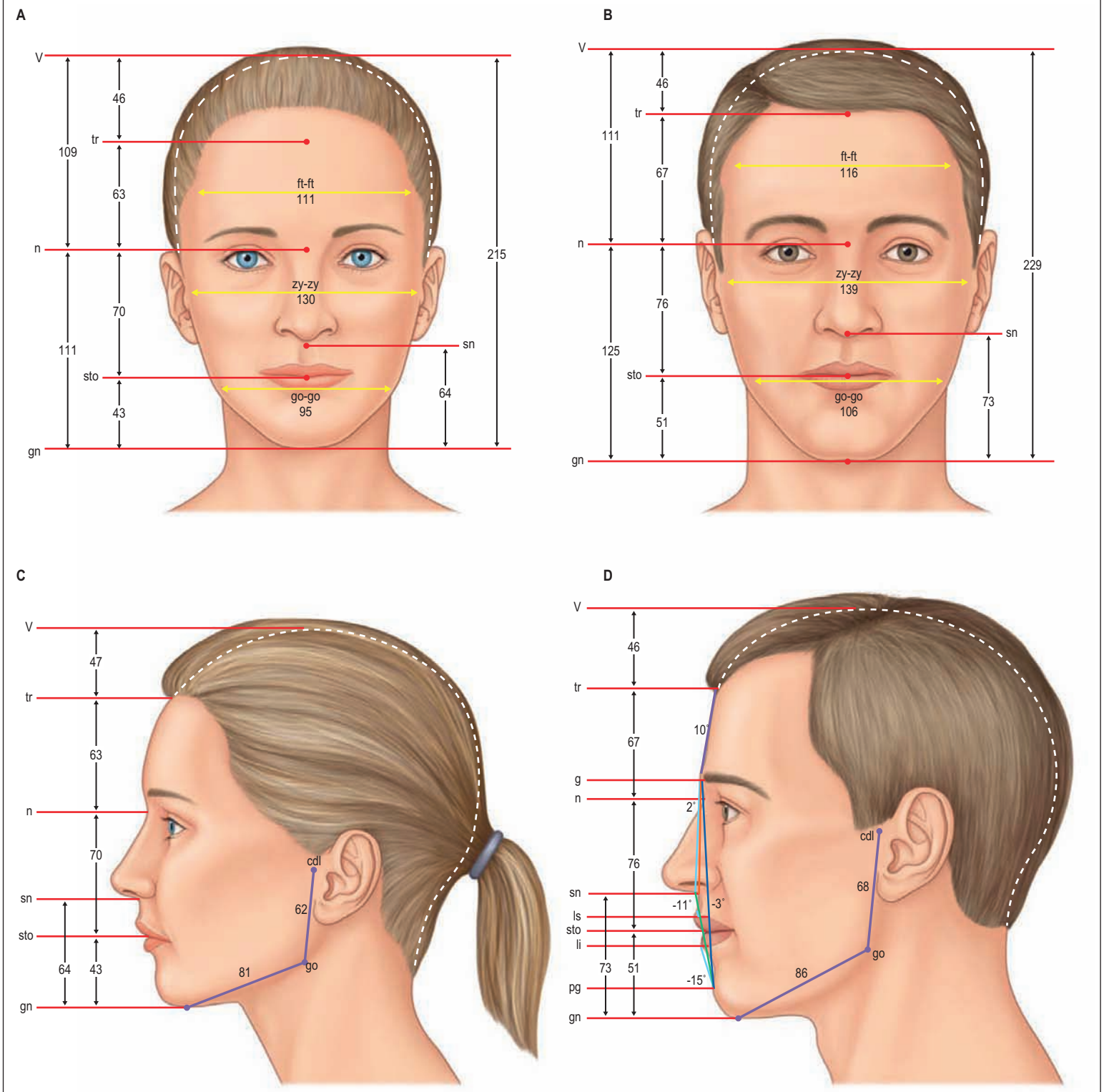


Fig. 14.4 Frontal and lateral views of female and male faces drawn from average anthropometric measurements for 21 year old North American Caucasians. Measurements are in millimeters. A, Frontal view female. B, Frontal view male. C, Lateral view female. D, Lateral view male.

ALLOPLASTIC MATERIALS

Implant materials used for facial skeletal augmentation are biocompatible – that is, there is an acceptable reaction between the material and the host. In general, the host has little or no enzymatic ability to degrade the implant with the result that the implant tends to maintain its volume and shape. Likewise, the implant has a small and predictable effect on the host tissues that surround it. This type of relationship is an advantage over the use of autogenous bone or cartilage which, when revascularized, will be remodeled to varying degrees, thereby changing volume and shape.

The presently used alloplastic implants used for facial reconstruction have not been shown to have any toxic effects on the host.[4] The host responds to these materials by forming a fibrous capsule around the implant, which is the body's way of isolating the implant from the host. The most important implant characteristic that determines the nature of the encapsulation is the implant's surface characteristics. Smooth implants result in the formation of smooth-walled capsules. Porous implants allow varying degrees of soft tissue ingrowth that results in a less dense and defined capsule. It is a clinical impression that porous implants, as a result of fibrous incorporation rather than encapsulation, have a lower tendency to erode underlying bone or migrate due to soft tissue mechanical forces and, perhaps, are less susceptible to infection when challenged with an inoculum of bacteria. The most commonly used, commercially available materials today for facial skeletal augmentation are solid silicone, and porous polyethylene –Medpor (Porex, Fairborn, GA). Eppley[5] has summarized the attributes of these materials.

The surface characteristics of an implant influence the surrounding soft tissue's response to the implant. Smooth-surfaced implants induce denser capsule formation than porous implants.

Polysiloxane (silicone)

Solid silicone or the silicone rubber used for facial implants is a vulcanized form of polysiloxane. Polysiloxane is a polymer created from interlinking silicone and oxygen with methyl side groups and, as such, is the only non-carbon chain polymer used in medical implantation. Solid silicone has the following advantages: it is easily sterilizable by steam or irradiation, it can be carved easily with either a scissors or scalpel, and it can be stabilized with a screw or suture. There are no known clinical or allergic reactions. Because it is smooth, it can be removed quite easily. Disadvantages include the tendency to cause resorption of underlying bone (particularly when used to augment the chin), the potential to migrate if not fixed, and the potential for its fibrous capsule to be visible when placed under thin soft tissue cover.

Porous polyethylene

Porous polyethylene – Medpor (Porex, Fairborn, GA) – is a simple carbon chain of ethylene monomer. Porous polyethylene is firm but flexible. Its intramaterial porosity is between 125 and 250 μm, allows fibrous tissue growth into the surface of the implant. The porosity of this implant has both advantages and disadvantages. Soft tissue growth into the implant lessens the tendency to migrate and to erode underlying bone. Its firm consistency allows it to be easily fixed with screws and contoured with a scalpel or power equipment without fragmenting. However, its porosity causes its soft tissue to adhere to it, making placement more difficult and requiring a larger pocket to be made than with smoother implants. The soft tissue ingrowth also makes implant removal more difficult.

REQUISITES OF IMPLANT SHAPE, POSITIONING, AND IMMOBILIZATION

Shape

The external shape of the implant should mimic the shape of the bone it is augmenting. Its posterior surface should be one that molds to the bone to which it is applied. The implant margins must taper imperceptibly into the bone they are augmenting so that they are neither visible nor palpable.

Positioning

Although some surgeons prefer to place implants in a soft tissue pocket, clinical experience has led this surgeon to adopt a policy of strict subperiosteal placement. Placement in a subperiosteal pocket involves a dissection that is safe to peripheral nerves and relatively bloodless. It allows visualization and, therefore, more precise augmentation of the skeletal contour desired for augmentation.

The size of the pocket will be determined by the type of implant used and its method of immobilization. The long-standing teaching using smooth silicone implants is to make a pocket just large enough to accommodate the implant and, therefore, guarantee its position. Porous implants require a larger pocket, because they adhere to the soft tissues during their placement. This author, whether using smooth or porous implants, dissects widely enough to have a perspective of the skeletal anatomy being augmented, which allows more precise, symmetric implant positioning.

Wide subperiosteal exposure of the area to be augmented optimizes accuracy of implant placement.

Immobilization

Facial implants should be immobilized. Many surgeons stabilize the position of the implant by suturing it to surrounding soft tissues or by using temporary transcutaneous pull-out sutures. Screw fixation of the implant to the skeleton is preferred. Screw fixation prevents any movement of the implant and also assures application of the implant to the surface of the bone. Because each facial skeleton has a unique and varying surface topography, a non-conforming implant will leave gaps between the implants and the skeleton. These gaps between the implant and the skeleton are problematic for two reasons. The space between the implant and the skeleton is equivalent to an additional augmentation. This can lead to over-augmentation and asymmetries. Gaps are also potential spaces for hematoma and seroma formation (Fig. 14.5). Finally, screw fixation allows for final contouring with the implant in position. This final contouring is particularly important where the implant interfaces with the skeleton. Any step-off between the implant and the skeleton will be palpable and possibly visible in patients with thin soft tissue cover.

Screw fixation not only prevents implant movement but also obliterates gaps between the implant and the native skeleton. Gaps result in unanticipated increase in implant augmentation.

MIDFACE IMPLANTS

Virtually all aesthetic augmentation is performed on the middle and lower thirds of the facial skeleton. The midface is best conceptualized as having three zones, alone, or in combination, appropriate for aug-

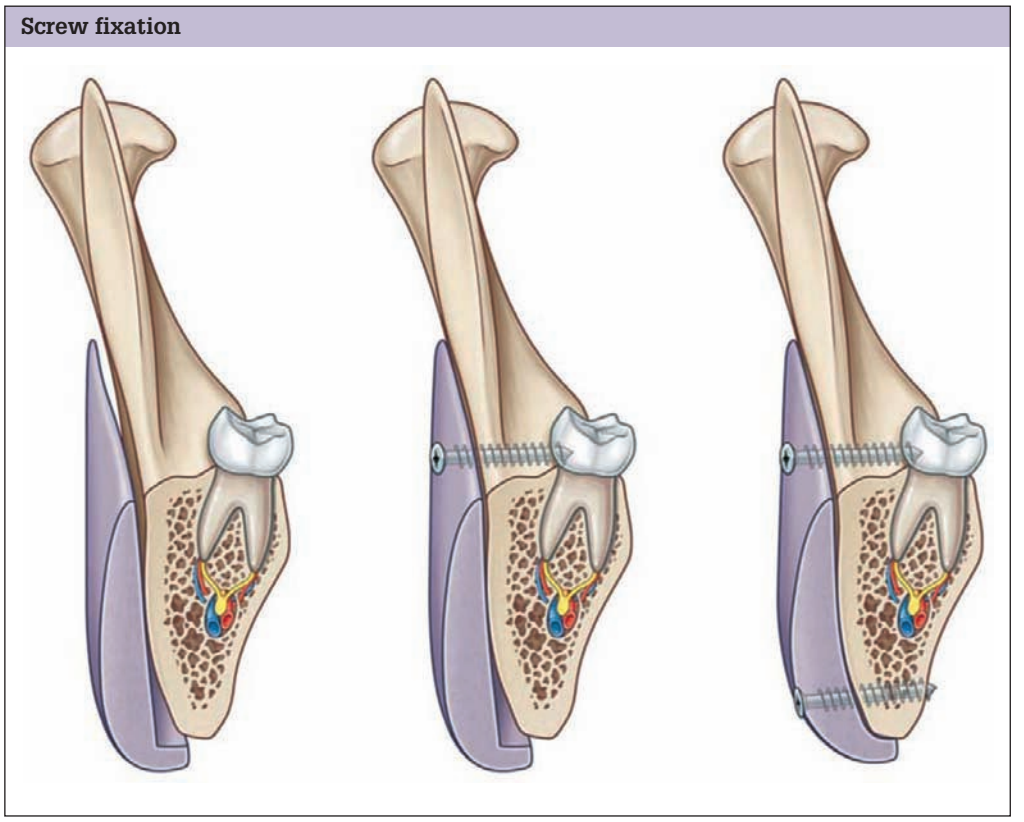


Fig. 14.5 Screw fixation applies the implant to the skeleton and obliterates the gaps which are equivalent to an increase in augmentation. A, Without screw fixation there are gaps between the posterior surface of the implant and the anterior surface of the mandible. B, The screw at the upper border applies the implant to the skeleton. C, The lower screw now obliterates all gaps. The posterior surface of the implant is congruent with the anterior surface of the mandible. The amount of augmentation is equivalent to the thickness of the implant only.

mentation. Implants are designed to augment the infraorbital rim, the malar area, and the pyriform aperture.

Infraorbital rim

Because the infraorbital rim and upper midface skeleton support the lower eyelids and the cheek soft tissues, their projection impacts on lid and cheek position. Patients with retrusive skeletons are more likely to undergo premature lower lid and cheek descent with aging. This lack of skeletal support predisposes to lower-lid malposition after blepharoplasty and limits the efficacy and longevity of midface lifting.

Deficient infraorbital rim projection predisposes to lower-lid descent with aging.

Deficient infraorbital rim projection predisposes to lower-lid descent after blepharoplasty.

Jelks and Jelks[6] categorized globe–orbital rim relationships and the tendency for the development of lower-lid malposition after blepharoplasty. On sagittal view, they placed a line or "vector" between the most anterior projection of the globe and the malar eminence and lid margin. A "positive" vector relationship exists when the most anterior projection of the globe is posterior to the lid margin and the malar eminence. A "negative" vector relationship exists when the most anterior projection of the globe lies anterior to the lower lid and the malar eminence. See Fig. 14.6. They warned that, patients whose orbital morphology has a negative vector relationship are prone to lid malposition after lower blepharoplasty.

Augmentation of the infraorbital rim in patients with a retruded infraorbital rim can bring it into a better relationship with the globe, thereby "reversing the negative vector".[7] See Fig. 14.6.

Infraorbital rim augmentation is part of the strategy for normalizing the appearance in patients who are "morphologically prone". It can be adapted for morphologically prone patients who are first seeking improvement in their periorbital appearance or for those whose lid malposition and round-eye appearance that has been exaggerated by previous lower blepharoplasty.[8]

Infraorbital rim augmentation can provide support for the resuspended lower lid and cheek in patients with midface skeletal deficiency.

Surgical technique

The infraorbital rim and adjacent anatomy must be exposed sufficiently to assure ideal implant placement, smooth implant facial skeleton transition, and screw fixation. Direct, subciliary skin or skin muscle-flap incisions can provide this exposure. A transconjunctival incision alone is inadequate for implant placement or screw stabilization. Use of a transconjunctival retroseptal incision requires lengthening with a lateral canthotomy or combination with intraoral and coronal incision. It is important to identify the infraorbital nerve that exits from the infraorbital foramen about 1 cm below the margin of the orbit. This may be 3–6 mm in patients with significant maxillary hypoplasia – usual candidates for this surgery. The orbicularis oculi and the origins of the lip elevators are separated from the underlying skeleton in a subperiosteal plane to expose the infraorbital rim. The implant is carved to fit the specific needs of the patient. Segmenting the implant may facilitate placement of the implant through limited skeletal access. The implant is fixed to the skeleton with titanium screw. This technique is summarized in Fig. 14.7. A clinical example is shown in Fig. 14.8.

Pyriform aperture

The average North American Caucasian face is convex (Figs 14.4). A relative deficiency in lower midface projection may be congenital or

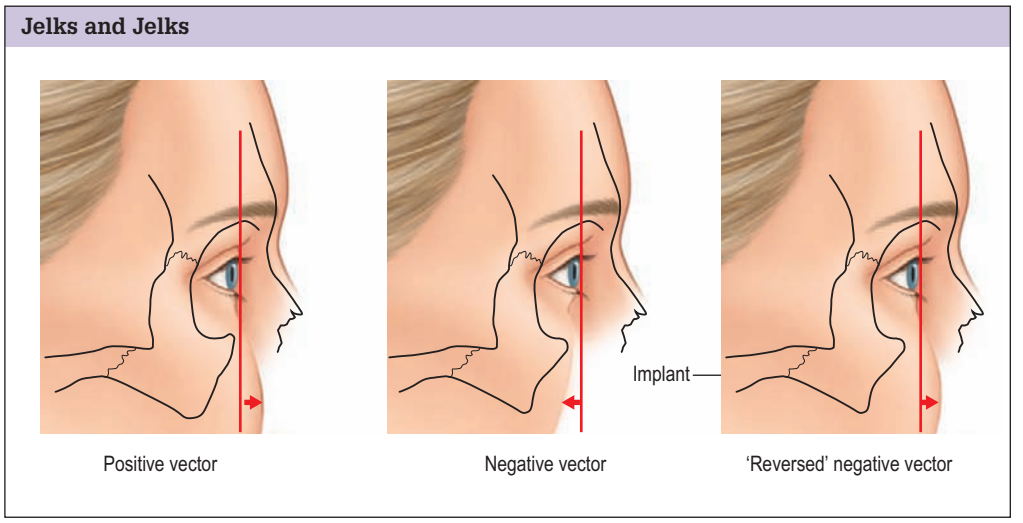


Fig. 14.6 Jelks and Jelks[118-6] categorized globe-orbital rim relationships by placing a line or "vector" between the most anterior projection of the globe and the malar eminence and lid margin. (*Left*) Positive vector relationship. In the youthful face with normal globe-to-skeletal rim relations, the cheek mass supported by the infraorbital rim lies anterior to the surface of the cornea. The position of the cheek prominence beyond the anterior surface of the cornea is termed a positive vector. (*Center*) Negative vector relationship: In patients with maxillary hypoplasia, the cheek mass lies posterior to the surface of the cornea. The position of the cheek prominence beyond the anterior surface of the cornea is termed a negative vector. (*Right*) 'Reversed'-negative vector relationship: Alloplastic augmentation of the infraorbital rim can reverse the negative vector. After Yaremchuk, M.J. Restoring palpebral fissure shape after previous lower blepharoplasty. *Plast. Reconst. Surg*. 111:441-450.

may be acquired, particularly after cleft surgery and trauma. Patients with satisfactory occlusion and lower midface concavity can have their aesthetic desires satisfied with skeletal augmentation. Implantation of alloplastic material in the paranasal area can simulate the visual effect of LeFort I advancement and other skeletal manipulations.[9]

Pyriform aperture augmentation increases the projection of the nasal base and, therefore, opens the nasolabial angle.

Surgical technique

Paranasal augmentation is done through an upper gingivobuccal sulcus incision made just lateral to the piriform aperture to avoid placing incisions directly over the implant. An adequate cuff of mucosa is left to allow layered closure. Subperiosteal dissection exposes the area to be augmented. The infraorbital nerve is identified and preserved. The patient's anatomy will determine whether the entire crescent or just the horizontal or vertical limb of the crescent will be utilized. The root of the canine usually lies in the field to be augmented and should be avoided if the implant is immobilized with screws. A patient who underwent aesthetic rhinoplasty and augmentation of the pyriform aperture area is shown in Fig. 14.9.

The implant may compromise the nasal airway if malpositioned.

Malar

Prominent malar bones are considered attractive. Hence, the malar area is frequently augmented with implants.

The lack of anthropometric and cephalometric landmarks precludes the availability of normative data making analysis and augmentation of the malar area largely subjective. Malar deficiency is often part of a generalized midface deficiency for which malar augmentation alone may be inadequate or, even, inappropriate. Clinical experience has shown that when malar projection is deemed inadequate, malar augmentation is most effective when it recreates the contours of a normal skeleton with prominent anterior projection. Malar skeletal augmentation is not a substitute for soft tissue augmentation or repositioning.

Since full cheeks are associated with youth, malar augmentation is often performed to provide a youthful appearance. This may provide an aesthetic benefit if there is a relative malar hypoplasia or if the implants are of modest size and projection. This skeletal augmentation is not equivalent to a soft tissue augmentation or resuspension. Similarly, malar implants are often advocated as a means to obliterate lower-eyelid wrinkles or secondary bags. Malar augmentation impacts poorly on these surface irregularities. More often, they detract from periorbital aesthetics by contributing to lower-lid malposition, particularly when placed through an eyelid approach.[10]

Skeletal augmentation is not a substitute for soft tissue augmentation or resuspension.

Surgical technique

Malar augmentation can be performed through intraoral, coronal, or eyelid incisions. It is the author's preference to access the malar midface through an intraoral approach.

An upper buccal sulcus incision is mad e far enough from the apex of the sulcus so that sufficient labial tissue is available on either side for a secure two-layer closure. Taking care to identify the infraorbital nerve, subperiosteal dissection is carried over the malar eminence and onto the zygomatic arch almost up to the zygomaticotemporal suture. The pocket size should allow precise insertion of the implant to the area of the skeleton desired for augmentation.

Extending a malar implant onto the zygomatic arch has a profound impact on midfacial width.

Although implants with greater projection are available, I rarely provide more than 3 mm of augmentation at the point of maximum projection. Larger implants will become obvious with time as the

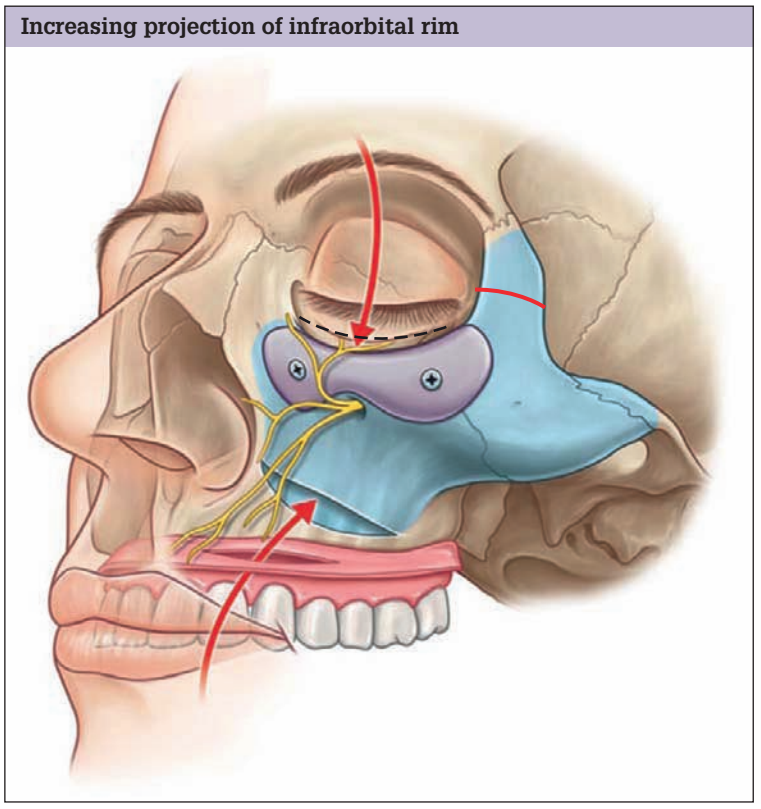


Fig. 14.7 Overview of operation to increase projection of infraorbital rim and "reverse the negative vector" in patients with upper midface skeletal deficiency. I prefer a transconjunctival retroseptal incision *(broken line)* with the lateral extent of a lower-lid blepharoplasty incision *(solid line)* to expose the infraorbital rim. This approach preserves the integrity of the lateral canthus, and hence, the palpebral fissure. Transcutaneous blepharoplasty or transconjunctival with lateral canthotomy incisions are alternative approaches which provide greater exposure but are accompanied by a greater risk of palpebral fissure distortion. An intraoral incision (*broken line*) is use to access the lower midface skeleton and to identify and protect the infraorbital nerve. The lower-lid and midface soft tissues are freed by subperiosteal dissection. The implant is immobilized with titanium screws.

overlying soft tissues atrophy and sag. The capsule formation that accompanies smooth-surfaced implants further exaggerates the tendency towards implant visibility.

Large malar implants will become visible with time.

In my experience, implants with large surface areas do not mimic natural skeletal topography and cause unnatural implant-dictated contours. The intraoperative position of both smooth and porous implants can be guaranteed with screw fixation of the implant to the skeleton. See Figs 14.10 and 14.11.

MANDIBLE IMPLANTS

Each of the anatomic areas of the mandible – chin, body, angle and ramus – may be deficient and are amenable to augmentation with alloplastic materials. For further information on the chin please see Chapter 13, Genioplasty.

Ramus, angle, and body

Alloplastic augmentation of the mandibular ramus and body can have a dramatic impact on the appearance of the lower third of the face. Two patient populations have had their aesthetic concerns satisfied with mandibular augmentation procedures. One group has mandibular dimensions that relate to the upper and middle thirds of the face within the normal range. These patients perceive a wider lower face as an enhancement to their appearance. Patients in this treatment group often present with a desire to emulate the appearance of models and actors who have a defined, angular lower face. This patient group benefits from implants designed to augment the ramus and posterior body of the mandible and, in so doing, increase the bigonial distance (Fig. 14.4 and 14.5).

The other major group of patients who benefit from augmentation of the mandibular ramus and body are those patients with skeletal mandibular deficiency who have their malocclusion treated with orthodontics. The skeletal anatomy associated with mandibular deficiency, which can be camouflaged with implants designed to augment the ramus and body of the mandible include the obtuse mandibular angle

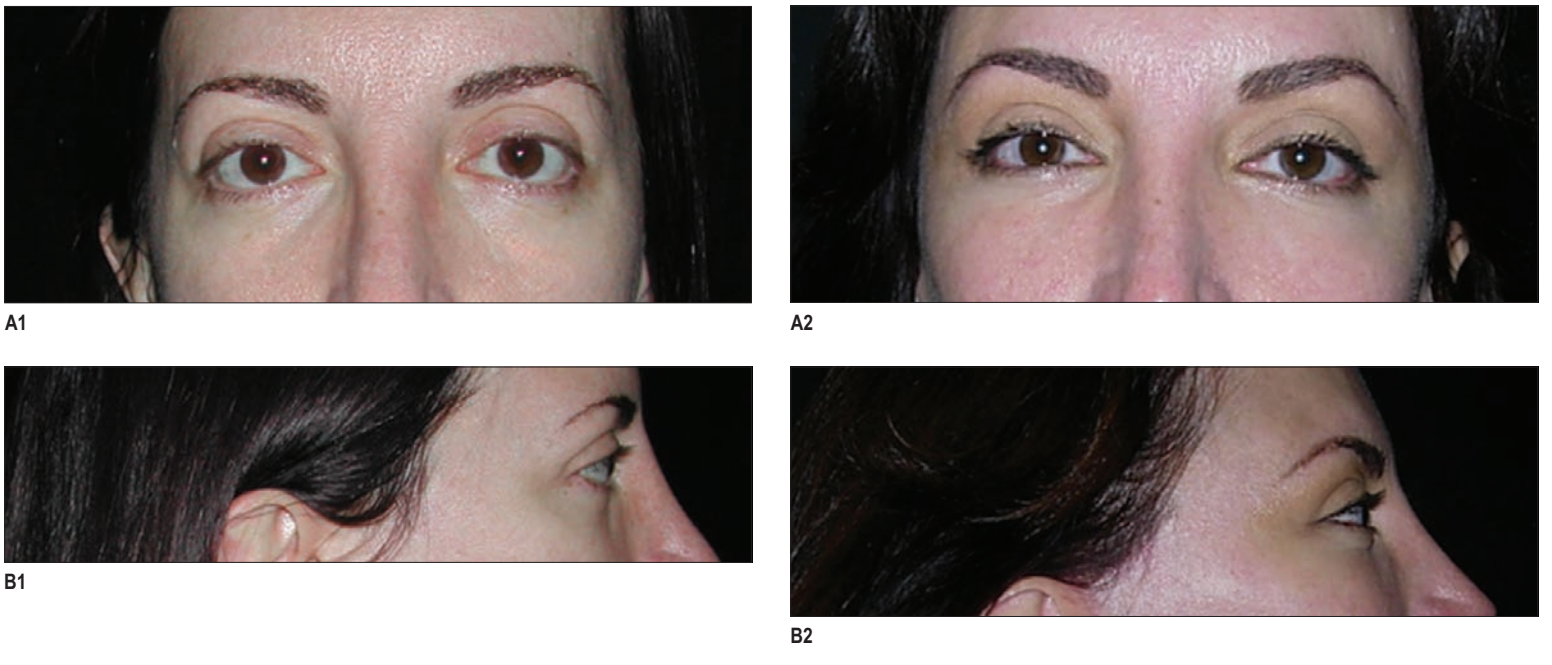


Fig. 14.8 Clinical example of a patient who underwent augmentation of the infraorbital rim with an alloplastic implant, subperiosteal midface lift, and lateral canthopexy. A, Pre and postoperative frontal views. B, Pre and postoperative lateral views.

A1

A2

B1

B2

Fig. 14.9 A 20-year-old woman underwent rhinoplasty and pyriform aperture augmentation. Note how augmentation of the pyriform aperture has changed the lower midface shape from concave to convex. A, Pre and postoperative frontal views. B, Pre and postoperative lateral views.

Operative technique for malar augmentation

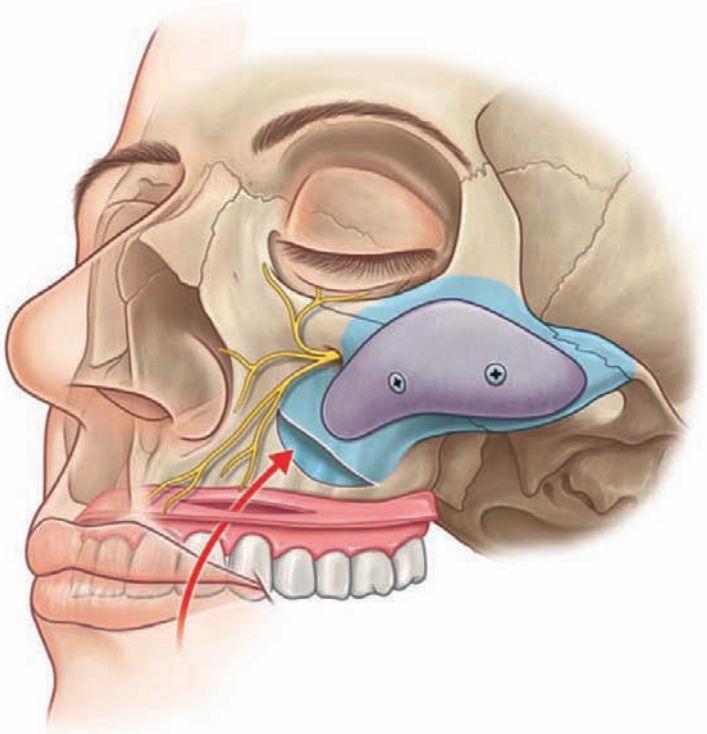


Fig. 14.10 Overview of the operative technique for malar augmentation. The upper buccal sulcus incision is at least 1 cm above the apex so that sufficient tissue is available for closure. Taking care to identify the infraorbital nerve, the subperiosteal dissection is carried over the malar eminence and onto the zygomatic arch just beyond the zygomaticotemporal suture. Implants are fixed with titanium screws. A trochar attached suction drain is placed. It exits through temporal hair bearing scalp. The broken line indicates the buccal sulcus incision. The dotted area denotes the area of subperiosteal dissection. The implant usually extends from the temperozygomatic suture on the zygomatic arch to just below the foramen of the infraorbital nerve. It does not extend beyond the malar bone into the submalar area.

with steep mandibular plane, as well as the decreased vertical and transverse ramus dimensions. The addition of an extended chin implant will camouflage the poorly projecting chin.[14]

Surgical technique

A generous intraoral mucosal incision is made to expose the ramus and body of the mandible. It is made at least 1 cm above the sulcus on its labial side. The anterior ramus and body of the mandible are freed from their soft tissues. If the mental area is also being augmented, a submental incision is made for access and exposure of the anterior mandible. The mental nerve is visualized as it exits its foramen to avoid its injury. It is important to free both the inferior and pos-terior borders of the mandible of soft tissue attachments to allow placement.

To assure the desired placement of the implant and its application to the surface of the mandible, the implant is fixed to the mandible with titanium screws. With vigorous retaction, this is performed intraorally (Fig. 14.12). This allows strategic unicortical screw fixation of the implant to the mandible. Usually two or three screws are used to obliterate any gaps between the mandible and the implant. Screws are placed to avoid the anticipated path of the inferior alveolar nerve prior to its exit from the mental foramen.

It is crucial to soften any transitions between the implant and the mandible, particularly where the implant extends beyond the anterior mandibular border's inferior edge. Any step-offs between the implant and the mandible in this area may be visible in thin patients. Screw fixation of the implants allows scalpel or mechanical burr final contouring with the implants in place. A small suction drain may be placed at the operative site that exits through the skin behind the ear. The incision is closed in two layers with absorbable sutures.

Make the intraoral incision at least 1 cm above the sulcus on the labial side to provide adequate soft tissue for two-layer closure and to avoid saliva pooling over the suture line in the early postoperative period.

A clinical example is shown in figure 14.13.

A1 A2 B1 B2

Fig. 14.11 A 24-year-old woman underwent malar augmentation, chin augmentation, and submental lipectomy. A, Pre and postoperative frontal views. B, Pre and postoperative oblique views.

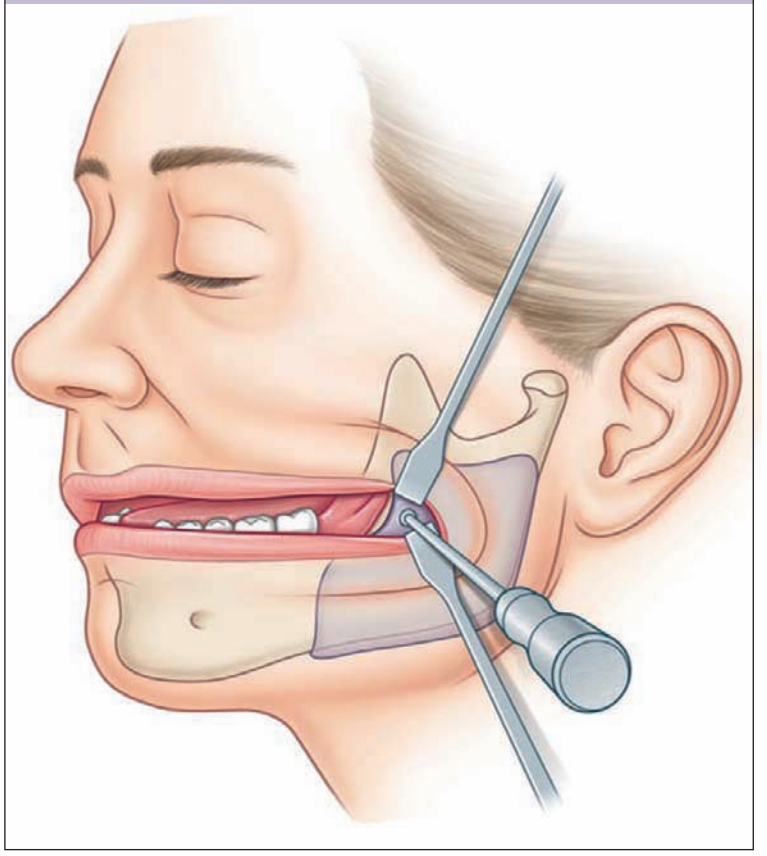


Fig. 14.12 Screw fixation of the implant to the mandible through an intraoral approach.

Implants used to camouflage soft tissue depressions

The implants discussed in this chapter are designed to increase the surface projection of the facial skeleton. Some surgeons have used implants placed on the facial skeleton to disguise overlying soft tissue volume inadequacy, usually due to involutional changes brought on by age. Submalar implants are used to expand midfacial depression and, in so doing, may reduce the prominence of the nasolabial fold.[15] Mittleman designed an extended chin implant shaped to camouflage the prejowl sulcus.[16] The sulcus develops due to some bone resorption along the border of the mandible and soft tissue atrophy directly over it. This depression exaggerates the jowl. Flowers designed an implant to fill out the "tear trough", the area that develops in some individuals medial to the infraorbital foramen between the thick cheek skin and thin eyelid skin.[17]

Skeletal versus soft tissue augmentation

The value of soft tissue repositioning and augmentation has been recognized and exploited during the last decade. Unfortunately, since the ultimate expression of skeletal or soft tissue structure is reflected on the skin's surface, some surgeons have used this as a justification for the equivalence and interchangeability of soft and hard tissue augmentation. For example, malar skeletal implants are used to restore cheek fullness while fat grafts are used to create malar prominence. Up to 1 mm or so, the visual effect of either augmentation modality may be equivalent depending on the thickness of the overlying soft tissue envelope. However, beyond a minimal augmentation, the visual effects of these modalities are markedly different. This is easily conceptualized when envisioning large augmentations. A large implant placed on the malar bone will make the cheek project more, making the face more defined, angular and, therefore, make the face appear thinner and more skeletal. Implanting fat into the cheeks will also make the cheek project more; however, the face will appear increasingly round and, therefore, less defined and less angular.

> Soft tissue augmentation does not provide the same visual effect as skeletal augmentation and vice versa.

COMPLICATIONS

The best available *data* support the biocompatibility of the currently used implant materials. No cases of cancer have been reported in association with a polymer craniofacial implant. True hypersensitivity reactions to prefabricated polymer implants are extremely rare.

There are no truly scientific data to document the surgical complication rate related to facial skeletal augmentation. Prospective studies that control for surgical technique, implant site, patient selection, and follow-up time do not exist. We reviewed almost 200 reports in the literature that provided sufficient data to compare complication rates related both to implant material and implant site.[4] The accumulation of these clinical *data* can provide some useful information about factors that can contribute to morbidity with implants. For example, the quality of the soft tissue coverage is clearly related to morbidity. Complication rates are lowest in the chin and malar region, where the soft tissue cover is relatively thick, and highest in the nose and ear, where the soft tissue cover is thin and often under tension from the underlying device. The surface characteristic of an implant may also be important. Porous implants allow a certain ingrowth of tissue which may allow the presence of host defenses within the implant to decrease the risk of infection. Given that several biomaterials are well tolerated in the human body, the actual chemical structure of an implant is important only to the degree that it influences the consistency and surface characteristics of the device.

In 2003, I reported my personal experience with porous implants used for facial skeletal reconstruction.[8] This report was based on experiences with 162 patients who were operated on over an 11-year period (1990–2001). In this series no implants migrated or were extruded, formed clinically apparent capsules, or caused symptoms attributable to bio-incompatibility. The overall reoperation was 10% ($n = 16$), which included operations to remove implants because of acute infection (2% – $n = 3$) or late infection (1% – $n = 1$), or to remove implants causing displeasing contours (2% – $n = 3$). The rate of complications has not changed in facial implant procedures in the subsequent 100 patients.

The presence of a foreign body decreases the minimal infecting dose of *Staphylococcus aureus* in an animal model due to impaired bacterial clearance.[19] If microorganisms are not eliminated rapidly from an implant surface they will adhere to the implant initially by non-specific physical forces and then by the formation of biofilms characterized by clustering together in an extracellular matrix attached to the implant.[20] Biofilms protect bacteria from host defenses and antibiotics. Only aggressive debridement and long-term suppressive therapy have been effective in treating orthopedic implant-related infections. This approach is usually not appropriate in facial implant patients since both debridement and chronic infection may be deforming in this appearance conscious population. Since antibiotic treatment alone is usually not successful, facial implant-related infections are treated by implant removal and appropriate wound care. Implants may be replaced in 6 to 12 months.

CONCLUSION

Augmentation of the facial skeleton with alloplastic materials can be a safe and effective way to alter facial appearance. Virtually any area of the facial skeleton can be augmented. A satisfactory result requires avoiding morbidity in the facial sensory and neuromuscular apparatus during surgical exposure, selecting sites with adequate soft tissue cover and using implants that merge imperceptibly with the adjacent skeleton.

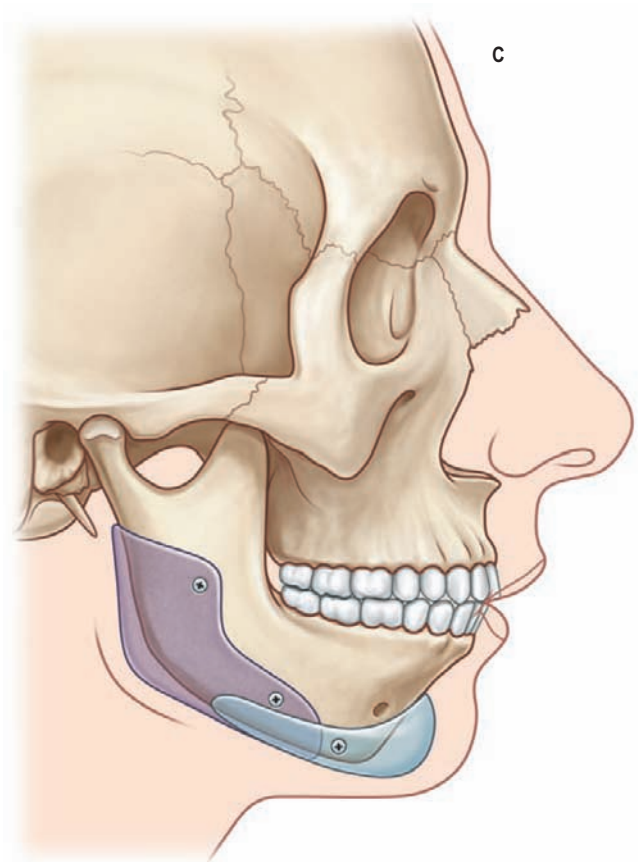
A1

A2

B1

B2

Chin and mandibular augmentation with alloplastic implants



C

Fig. 14.13 A 30-year-old with mandibular deficiency and orthodontically corrected occlusion underwent chin and mandibular augmentation with alloplastic implants. A, Pre and postoperative frontal views. B, Pre and postoperative lateral views. C, Artist's rendition of surgery.

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CHAPTER 15

Augmentation of Facial Structures with Autologous Fat

Sydney R Coleman and Alesia P Saboeiro

Summary

1. Fat can be grafted successfully to yield long-lasting, natural contour changes.
2. A variety of aesthetic and reconstructive issues can be addressed with structural fat grafting.
3. The addition of volume to the face can reverse many signs of aging that were previously addressed with procedures involving cutting and pulling of the skin.
4. Fat to be grafted must be harvested gently to preserve the natural architecture.
5. Fat should be refined by centrifugation and decanting to provide predictable volume changes.
6. Fat should not be stored or frozen for future use.
7. Grafted fat should be placed in very small aliquots using multiple passes.
8. Strict sterile technique should be maintained during the fat grafting procedure.
9. Grafted fat should not be molded after placement.
10. Structural fat grafting results in significant bruising and tissue edema.

INTRODUCTION

With renewed interest in volumetric enhancement for facial rejuvenation, fat grafting is once again gaining popularity. It has been used successfully for soft tissue augmentation since 1893[1] and in 1909 Eugene Hollander described a technique to transplant fat using a needle and syringe.[2] In 1926 Miller claimed that grafting fat through hollow metal cannulas gave a more natural and longer lasting correction than paraffin.[3] Soon after the introduction of suction curettage of body fat for contouring, Teimourian and Illouz described the injection of semi-liquid fat into liposuction deformities[4,5] and Chajchir described injecting suctioned fat into the face.[6] Although some of the initial results were positive[7,8] many were not.[9,10] Illouz compared the longevity of grafted fat in the face to that of collagen.[4] In the 1980s, many well-respected plastic surgeons denounced fat grafting based on negative results.[11,12] As techniques changed, more positive results were obtained and surgeons began to realize that grafted fat could result in long-lasting contour changes.[13–16] The technique developed by Coleman began in 1987 and evolved over the next few years to become a standard for fat grafting. It emphasizes basic sound surgical techniques with the gentle handling of tissues to make fat grafting predictable and reliable.

INDICATIONS AND CONTRAINDICATIONS

Indications

1. Facial rejuvenation – addresses hollowing, wrinkling and mild skin laxity.
2. Change in facial proportion – cheek, chin and mandibular augmentation.
3. Reconstruction – hemifacial microsomia, facial atrophy, trauma and post-surgical tissue defects (including facelifts).
4. Lipoatrophy secondary to disease – HIV related lipoatrophy.

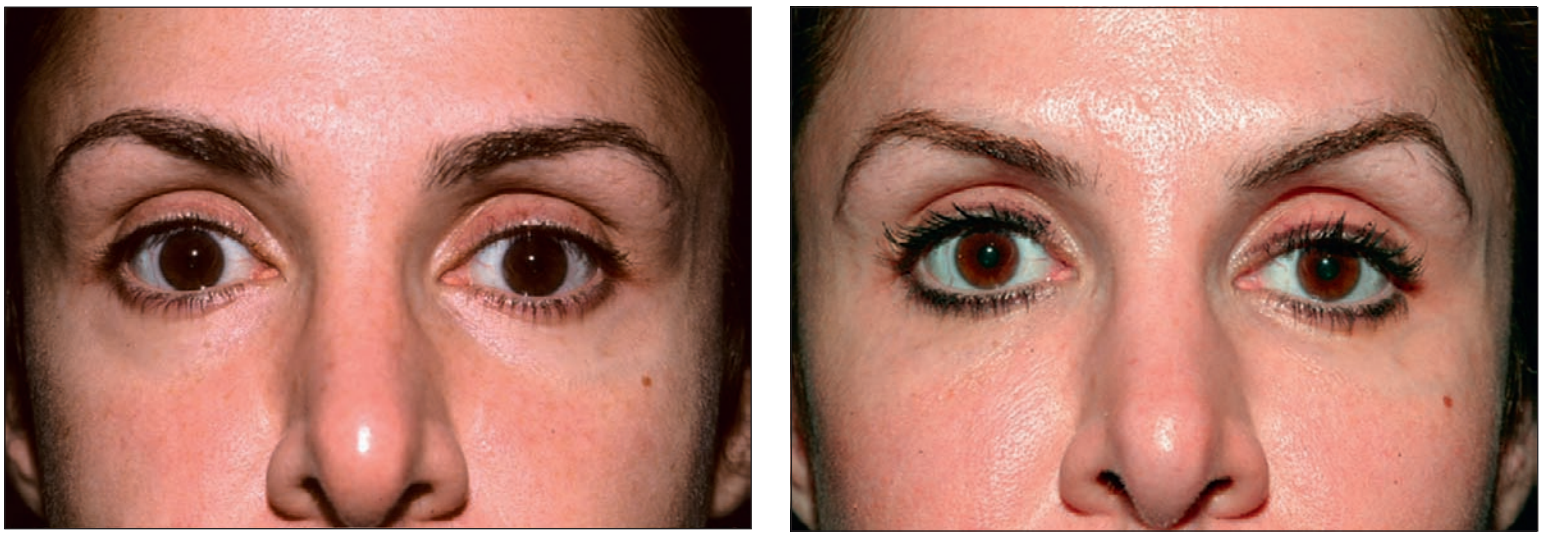
Contraindications

1. Poor health prohibiting anesthesia.
2. Extreme lack of body fat sufficient for transfer.
3. Unrealistic patient.

FAT GRAFTING FOR FACIAL REJUVENATION

The face of youth is full, soft and well defined. While traditional aesthetic facial procedures that involve cutting and pulling of the skin are sometimes beneficial, they do not replace the facial volume that diminishes with age. Fat grafting offers a permanent correction of the loss of volume that occurs over time. The idea of what is attractive will vary from culture to culture and person to person, but facial fullness is generally associated with youth. The attractive face, therefore, has a smooth brow and temples, full upper eyelids without excess skin, smooth lower eyelids, round but angular cheeks, minimal nasolabial folds, full lips, and a well defined chin and jaw line. The aging process results in predictable changes. With time, the temples begin to hollow and the upper and lower eyelids deflate, leaving behind either excess skin or hollowing of the orbit. A break occurs in the anterior cheek, flattening this area and accentuating the nasolabial folds, and the lips begin to invert. The anterior chin flattens and the jaw line becomes less defined and angular. The overall result appears as descent of the skin, but often by restoring the underlying volume alone, an apparent repositioning of the skin can be achieved. The use of photographs of patients at a younger age is extremely helpful in understanding the aging process and what is needed to restore a youthful face.

The cheek is a relatively easy area to visualize in three dimensions. The immediate, intraoperative results of cheek augmentation with fat are the most similar to what will be seen as the final result.[17] This is a good area to begin learning and practicing making three-dimensional changes in the face. On the other hand, the lower eyelid is one of the most difficult areas for structural fat grafting. Irregularities, lumps, and excess fat can easily be seen through the thin eyelid skin when the



A B

Fig. 15.1 Facial aging example
33 year old woman who presented complaining that her lower eyelids were no longer smooth and that her right cheek was indented. Fat was placed into the lower eyelids and cheeks bilaterally. Preoperative photo (upper) and post-operative photo (lower) 2 years and 9 months after the procedure.

swelling resolves. The lower eyelid should be approached with caution and only after gaining confidence in other more forgiving areas of the face.

Augmentation of the lips is a relatively simple procedure, but the anatomy of an attractive lip is often ignored and the lips are filled like tubes or sausages. A youthful, attractive upper lip has a distinctly protuberant white roll that tapers off from the Cupid's bow and becomes less obvious laterally. Under the Cupid's bow, the vermillion of the lip has a well-centered, distinct tubercle. The width of the upper lip comes from the less-distinct fullness laterally. Between the central tubercle and the lateral fullness, there is often a concavity or slight depression.

The lower lip has a slightly protuberant rim, which is less distinctive than the white roll of the upper lip. The fullness and depressions of an attractive lower lip are opposite to those of the upper lip, with a central cleft and more fullness laterally. The amount of vermilion visible is much greater in the lower lip than in the upper lip (Fig. 15.1).[18,19]

FAT GRAFTING FOR CHANGE IN FACIAL PROPORTION

The younger patient will present not with the typical signs of aging, but requesting a change in the contours of the face. The most commonly requested changes in facial proportion are for cheeks that are more prominent, full and angular; a chin that is more prominent anteriorly; and a mandibular border that is more angular and well defined. Again, the cheek is an easier place to start learning fat grafting. The natural cheek prominence should be identified as the malar prominence and the fullness should extend laterally toward the base of the helix. Some fullness should also be placed over the anterior cheek, creating a slight 'apple' effect.

Augmentation of the chin is accomplished by first placing fat over the entire anterior prominence of the mandible.[20] The shape of the chin is then sculpted by placing additional fat in two small balls, leaving a slight central cleft between them. This creates not only a more prominent chin, but also a shapelier chin.

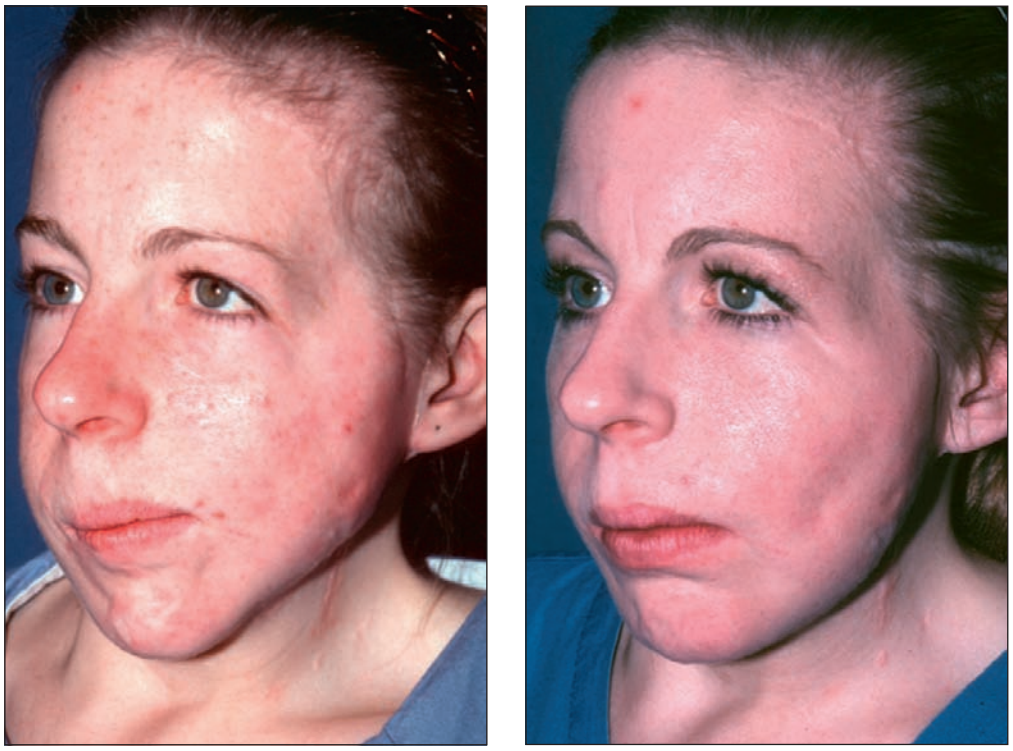
Mandibular augmentation creates a defined border separating the face from the neck. This is generally considered an attractive look and can be created by placing fat deep along the periosteum of the mandible as well as more superficially beneath the skin. The angle of the mandible should be identified and emphasized if it is not visible. A continuous line should then be developed from the angle to the chin (Fig. 15.2).

A B

Fig. 15.2 Facial proportion example
40 year old woman who presented complaining about a lack of pleasing facial contours, asymmetry, small lip, and a weak jaw line. Fat was placed throughout the face during four surgical procedures. Preoperative photo (left) and post-operative photo (right) 11 months after the last procedure.

FAT GRAFTING FOR RECONSTRUCTION

Fat can be placed deep along the facial bones as well as more superficially beneath the skin to correct many apparent deficiencies of both bone and soft tissue. It has been used successfully to correct defects such as hemifacial microsomia and atrophy, post-traumatic defects, and post-surgical defects.[21] Tissue lost after radical neck dissections can be supplemented with fat grafting to restore a normal facial appearance. In addition, the flattening of the posterior jaw line created by most facelift procedures can be corrected using fat grafts (Fig. 15.3).



A B

Fig. 15.3 Reconstruction example
26 year old woman who presented with left hemifacial microsomia secondary to 1st and 2nd branchial arch syndrome. She had multiple previous reconstructions, including rib and cranial bone grafts to the mandible, a silastic chin implant, and a rectus abdominus free flap, but she was still left with a significant deficiency on the left side and noticeable asymmetry. Fat was grafted along the left cheek and jaw line during two surgical procedures. Preoperative photo (left) and Post-operative photo (right) 3 years and 8 months after the second procedure.

A B

Fig. 15.4 Lipoatrophy example
A 45 year old woman who presented with lipoatrophy of her lower face. Fat was grafted to her nasolabial folds and anterior cheeks. Preoperative photo (upper) and post-operative photo (lower) 1 year and 2 months after the procedure.

FAT GRAFTING FOR LIPOATROPHY

There is a typical pattern of facial fat loss that occurs in patients who are HIV positive and who receive certain anti-retroviral medications. Unlike generalized aging, this loss of fat generally occurs in the buccal cheeks and is a characteristic of the disease. In addition, these patients may have loss of fat in the temples and in the periorbital region. All of these areas can be addressed with fat grafting to restore a healthier appearance to the patient. (Fig. 15.4)[22,23]

CONTRAINDICATIONS TO FAT GRAFTING

Like all elective procedures, patients in poor health and those with unrealistic expectations are not candidates for structural fat grafting. Other patients that are poor candidates are those with an extreme lack of body fat, such as the serious body builder, or those with anorexia.

PREOPERATIVE HISTORY AND CONSIDERATIONS

The primary unique consideration for the patient undergoing a fat grafting procedure is the present and future weight of the patient. Patients are ideally at their optimal weight and will not fluctuate significantly from that weight. Since the transferred/grafted fat remains viable, it will respond to weight changes as if it were still in its native site. Patients should understand that if they lose a significant amount of weight they can lose the correction obtained. Alternatively, if they gain a significant amount of weight, the fat placed may increase in

volume. Additionally, volume increases have been noted in some patients treated with anti-retroviral medications.

TECHNIQUE OF FAT GRAFTING

Harvesting

The detailed steps regarding harvesting of tissues have been previously described in the literature.[24–26] The main objective of the harvesting portion of the procedure is to gently obtain intact tissue parcels that will remain viable during the grafting process. The choice of harvesting sites is based only on the area of desired contour change, as no clear correlation has been made between the harvest site and longevity of grafted fat.[27,28] Small incisions are made adjacent to the harvest site and using a blunt lamis infiltrator, the tissue is infiltrated with 0.2% lidocaine with 1:200 000 epinephrine. Even when the patient is under general anesthesia, the local infiltration is performed for hemostatic purposes. Approximately 1 cc of anesthetic is infiltrated for each 1 cc of fat to be harvested. Superwet techniques should be avoided to maintain the architecture of the harvested fat. Fat is then harvested using a 10 cc syringe attached to a blunt, two-holed Coleman harvesting cannula. Syringes larger than 10 cc and plunger-locking devices are not used as these may create too much negative pressure and damage the parcels of fat. Instead, minimal negative pressure is created with the 10 cc syringe and the curetting action of the cannula. The most important consideration regarding harvesting of fat is maintaining the integrity of the fat cells and the normal architecture of the tissue. Any mechanical or chemical insult (straining, chopping, beating, washing) that damages this fragile tissue will result in eventual necrosis of the injected fat.

Refinement

After the fat has been harvested, the cannula is replaced with a Luer-Lok plug and the plunger is removed. The syringe is then centrifuged for 3 minutes at 3000 rpm. Centrifugation separates the almost pure fat from ruptured fat cells that present as an oil layer and the local anesthetic and blood that present as an aqueous layer. The oil layer is then carefully decanted off the top and the Luer-Lok is released to evacuate the lower aqueous layer. Neuropads are used to wick off any remaining oil and then the fat is transferred into 1 cc Luer-Lok syringes for placement into the face. This process of gentle refinement and removal of oil, blood and local anesthetic allows for more predictable results, as the volume change is, therefore, secondary only to the grafted fat. Fat should not be stored or frozen for future use. The necrosis of the fatty tissue that occurs with freezing will result in considerable resorption of the fat and the development of surface irregularities.

Placement

Depending on the extent of surgery, general, regional or local anesthesia may be used when fat is grafted. For larger body fat grafting cases, general anesthesia is preferred. Incisions for grafting the fat are positioned such that fat can be placed from at least two different directions. A blunt Type I Coleman cannula is used for the placement of the local anesthetic as well as the fat. Sharp needles should be used with extreme care in the subcutaneous planes for injection of local anesthetic and fat due to the risk of intravascular injection.[29] The infiltration cannula is attached to a 1 cc Luer-Lok syringe filled with refined tissue and the fat is distributed into the tissue planes only as the cannula is withdrawn. Very small aliquots of fat (0.02–0.1 cc) are placed with each pass of the cannula such that each parcel of fat is surrounded by native tissue to ensure access to a blood supply and stability of the transplanted tissue. The fat should be grafted such that the desired shapes are formed during the infiltration of the fat. Because the fat is integrated into the host tissue, attempts at significant molding of the fat after placement are usually futile and can cause undesirable irregularities.

With experience, the surgeon can predict the changes that will result when refined fat is placed in a certain area. However, even with a preconceived idea of the amount of fat to be placed in any area, the immediate appearance after grafting is an important indicator of the final result.

Unfortunately, many variables can alter the appearance immediately after grafting. The edema caused by the trauma of the blunt cannula can differ from person to person as well as from area to area. A hematoma, or even excessive bruising, can also mislead the surgeon. Muscle movement in the immediate postoperative period also may affect the stability or longevity of the grafted fat.

Fat grafting in the subcutaneous plane, as well as along the periosteum and into the muscle, has been described. The Coleman technique of structural fat grafting, however, does not promote the intentional placement of fat into the muscle, as it appears to cause a thickening of the muscle that is undesirable, especially in the lip. When correcting significant bony or structural deficiencies, it is usually essential to place fat deep along the periosteum and gradually add additional fat more superficially. Placement of fat in the subcutaneous plane gives a more significant volume change than the deeper, supraperiosteal grafts, and placement of fat just beneath the skin can result in an improvement in skin texture over time. Intradermal placement has been discouraged in the past, but has been revisited recently.[30] Using a sharp 22-gauge needle attached to a 1 cc syringe of refined fat, small amounts of fat can be placed intradermally into scars and deep wrinkles. The long-term effect of this method of placement does not appear to be as reliable as the subcutaneous placement with a larger bore cannula, however, and is different from the subcision technique described by Carraway.[7] Instead of undermining the area first with a sharp needle and then injecting the fat, it is recommended that the fat be placed first, followed by the release of any remaining adhesions or scar tissue using a 'v-dissector' or sharp needle afterward.[31] This maneuver, however, is traumatic and may destabilize the fat. It should be used with caution and should be delayed until the intradermal and subcutaneous placement is completed.

Optimizing outcomes

- Harvest fat gently with a 10 cc syringe to maintain intact tissue parcels.
- Avoid tumescent techniques.
- Refine the fat using centrifugation and decanting to increase predictability of results.
- Place very small (0.02–0.1 cc) aliquots of fat with each withdrawal of the cannula.
- Do not attempt to mold the grafted fat, but do ensure that it is smooth.

COMPLICATIONS OF FAT GRAFTING

Complications of fat grafting can be classified as acute or late. Acute complications include bleeding/hematoma, the frequency of which can be lessened with the use of a blunt cannula, and temporary injury to an underlying nerve or muscle. Fat is not intentionally placed into muscles, but occasionally edema in the area can inhibit or alter normal muscle movement. As the edema resolves, patients generally recover completely.

The most devastating and fortunately rare complication is an intravascular embolization.[29] This has never occurred when using a

blunt cannula. Therefore, sharp needles are discouraged, except when placing fat directly into the dermis. In addition, large boluses of fat should not be injected and injection guns should not be used when grafting fat.

Late complications include infections, which can result in resorption of the grafted fat. Strict sterile technique must be employed and cannulas that penetrate the oral mucosa should be considered contaminated and replaced. If lip augmentation is performed as part of a total facial rejuvenation procedure, it should be performed last. As previously mentioned, an increase or decrease in the size of the grafted area secondary to weight gain or loss can occur. Cosmetic concerns resulting from either too much or too little fat placed in an area as well as lumps and irregularities can occur. With experience, more accurate estimations of the correct volume and more precise placement techniques will be possible. In addition, contour deformities can occur in the donor site areas and incisions can remain visible for a prolonged period. Fat must be harvested carefully to avoid irregularities. Incisions can be lubricated with the oil obtained after centrifugation and/or revised later. This is not a complete list of complications and more exhaustive descriptions of potential complications[32] and untoward effects are available.

POSTOPERATIVE CARE

The tissue trauma that occurs with the placement of fat in the manner described results in a significant amount of bruising and tissue edema. To help minimize the bruising and swelling, Tegaderm® is placed over the infiltrated areas immediately after the procedure and this remains in place for 3 or 4 days. In addition, cold therapy is employed for 72 hours postoperatively.

Light touch can be instrumental in reducing swelling by encouraging lymphatic drainage. Deep massage, however, should be avoided in the first weeks after fat grafting. Although it is difficult to move the recently infiltrated fat, strong directed pressure could displace the fat and force it into an undesirable area. Recovery from this procedure usually requires a minimum of 2 weeks and sometimes as long as 6 weeks.[32]

CONCLUSION

Fat grafting using a blunt cannula has been used by plastic surgeons for altering the appearance of the face for almost 100 years. This autologous tissue is completely biocompatible and, therefore, is usually the safest choice for altering facial volume or contours. Furthermore, fat grafts can be placed such that they are long lasting, completely integrated and natural appearing. Concurrent with the development of fat grafting, our understanding of aging and methods of rejuvenation have also developed. We now approach facial rejuvenation and facial proportion with a better understanding of the need for volume to accomplish the desired changes.

Fat is fragile tissue that may not survive the trauma of harvesting, refinement or placement into a recipient site. Each step in the process has the potential to injure the fat cell or destroy the fatty tissue architecture. Gentle handling of the tissues and placement of tiny aliquots of fat is fundamental to the success of this technique. Grafting of fat in this manner allows for significant contour changes and longevity of the correction. It also, unfortunately, causes a tremendous amount of bruising and swelling, which must be emphasized prior to the procedure.

The outcome of fat grafting is not only surgeon dependent, but also dependent on the technique used to harvest, refine and place the fat. In addition, the effects of grafted fat differ between recipient sites and from patient to patient. Because of this variability, the results of fat grafting can be unpredictable. Directed research will help us to better understand this variability so that the most consistent results may be obtained.

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CHAPTER 16

Breast Augmentation

Per Hedén

Summary

To achieve successful breast augmentation results, it is crucial to:

1. understand patient desire and establish realistic patient expectations
2. not select an arbitrary implant volume
3. measure and analyze dimensions and proportions of existing breast and thorax
4. select implant width in relation to current and desired breast width
5. use dimensional analysis during preoperative markings. Calculate vertical implant position in relation to implants' base plate dimensions
6. calculate and mark new nipple to inframammary fold distance in relation to:
   - **a.** base width and projection of the implant
   - **b.** amount of glandular tissue
   - **c.** envelope characteristics
7. select sub-muscular or sub-glandular implant position depending on the amount of covering glandular tissue. Use some type of dual plan submuscular positioning with release of inferior medial origin in majority of cases
8. commonly use sub-mammary fold approach
9. use local anaesthesia even under general anaesthesia
10. use cutting cautery, avoid blunt implant pocket dissection and leave loose connective tissue on ribs if sub-muscular position is selected.

INTRODUCTION

The female breast is a universal symbol of sexuality, motherhood and femininity today, dating back even to the time of ancient cave paintings. In the 1940s Alfred Kinsey observed that the female breast could inspire more sexual arousal in men than the sex organ.[1] Since its introduction in 1962, modern breast augmentation with implants has become one of the most common aesthetic procedures, receiving more media attention than any other. However, much reporting, especially in the non-professional literature, has been faulty. More than one million breast implants are now inserted every year, 250 000 in the US. Most patients are very satisfied with the results.[2] Most experience better psychological functioning and body image; many experience less anxiety and depression[3] and even have better sexual relations with their partners. However, most women do not seriously contemplate the possibility of unfavourable results.[4] Various complications are possible and should be seriously considered before undergoing a procedure. The risk should be minimized by a meticulous preoperative evaluation and surgical procedure. Selecting the ideal dimensions for implants, based on biological prerequisites, is crucial.

PATIENT AND IMPLANT SELECTION, INDICATIONS AND CONTRAINDICATIONS

Indications

1. Developmental breast hypoplasia or asymmetry
2. Involutional breast deformity as a result of:
   - **a.** weight loss
   - **b.** pregnancy and breast feeding
3. Patients with normal breast volume who desire a more youthful appearance.

Contraindications

1. Patients with unrealistic expectations or abnormal desires
2. Psychiatrically or psychologically unfit patients.

Implant selection should be based on:

1. patient desires
2. width of existing glandular tissue and desired breast width
3. thorax shape
4. envelope characteristics
5. amount and shape of glandular tissue.

The reason why a patient seeks breast enhancement may be inborn or acquired. Indication is frequently divided into the following:

A. Developmental breast hypoplasia or asymmetry;

B. Involutional breast deformity due to weight loss or following pregnancy and breast feeding.

The third indication may be patients with relatively normal breast volume who wish to have larger, more youthful breasts. In this group, patients who are psychologically unsuitable for surgery are more common.

The general public and even the media have many misconceptions about the typical patient. The stereotype is a young woman who wants to have bigger breasts. Instead, the typical patient is a professional woman with children, 30–40 years of age, who does not wish to have big breasts, but larger, more youthful ones that are in harmony with her appearance. Mastopexy procedures are common to rejuvenate the female breast, but do have limitations in achieving the most youthful appearance in the upper pole. Breast implants can produce a more long-term and stable youthful upper pole.

CONTRAINDICATIONS

The main contraindications are psychological. Patients must have realistic expectations of the procedure and understand benefits and risks. Those who do not understand, or are psychiatrically unstable and have unrealistic expectations are contraindicated. Clearly, a

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14 Male-to-Female Gender Reassignment Surgery

Britt Colebunders, Wim Verhaeghe, Katrien Bonte, Salvatore D'Arpa, and Stan Monstrey

History of Transwomen Surgery

Abraham was the first to describe an intentional sex change operation in a transsexual patient in 1931; however, this was certainly not the first use of surgery to relieve the agony of persons with irreversible gender dysphoria (Abraham 1931; Edgerton 1974). Already in ancient times people have witnessed the methods and effects of animal castration and, therefore, self-castration must have been one of the most rudimentary attempts to employ surgical solutions. Eunuchs often underwent the procedure by force in order to remove their sexuality but it is unknown to what extent their castrations were voluntary. It is quite likely that hundreds or thousands of transsexuals have sought and undergone surgeries far riskier and more dramatic in effect than mere castration. It is unknown when such practices first occurred, but such surgeries were recorded in ancient Greece and particularly in Rome, known for being sexually permissive. The Roman emperor Elagabalus (204–222), a young successor to Marcus Aurelius, and a documented transvestite, was one of the first to undergo some form of sex change surgery at the hands of the skillful Roman doctors practicing in that era. It remains unclear if this procedure was successful, as little is known about Elagabalus other than that he was killed at age 18 (Wikipedia.org/wiki/Elagabalus).

Two rather crude, self-inflicted operations were described in 17th-century personal diaries as providing great and lasting subjective relief of gender dysphoria. These emasculating tactics were suppressed in the Christian world (with the exception of the castration of boys to maintain voice quality), but in Asia they have continued to the present times, notably in Southeast Asia, India and surrounding countries where young transwomen joined the Hijra caste and voluntarily underwent emasculating surgery under rather primitive conditions.

The development of modern gender reassignment surgery began in earnest in the 20th century when, following rapid advances in the fields of endocrinology and plastic surgery after World War II, comprehensive medical and surgical treatments for transsexualism started to become available.

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In 1952, the Danish plastic surgeon Paul Fogh-Andersen initiated the modern era of sex reassignment surgery (SRS) by using penile skin as a full-thickness graft to line the neovagina of Christine Jörgensen (Fogh-Andersen 1956). This "change of sex" of a U.S. citizen was widely reported by the media, and Ms. Jorgensen became world-famous. In the United States, these surgeries were still widely unknown by then. Under intense pressure from religious groups, and in response to the publicity generated by the Jörgensen case, most U.S. hospitals enacted policies that expressly prohibited such operations. During that time, a number of severely gender-dysphoric individuals in the United States resorted to auto-castration in an attempt to feminize and bypass hospital regulations. If one rid oneself of the testicles, a hospital might complete SRS, provided the patient had the available funds.

In most countries, the laws defining sex remained hazy, and the legality of changing sex was even more obscure. Moreover, surgeons were afraid that patients might come to regret surgery, lapse into psychosis, and sue the surgeon for mayhem.

Things began to change in the United States and beyond, during the late 1950s, when several hundred transsexuals came under the care of Dr. Harry Benjamin, a compassionate endocrinologist. Benjamin was the first physician to elucidate the nature of gender dysphoria. Rather than perceiving transsexuals as mentally ill deviants, as did most psychiatrists of that era, he understood that transsexuals suffered from an authentic "misgendering" condition of unknown origin. In an effort to ease suffering, he prescribed estrogen to selected patients. He monitored the results of the few transsexual surgeries being performed and referred the most severely dysphoric patients to reconstructive surgeons.

Benjamin was aware that operations were being performed furtively in the United States, and occasionally in Mexico (e.g., by José Jesus Barbosa) and Italy. However, for the majority of transsexuals seeking surgery, the Clinique du Parc in Casablanca, Morocco, was the place of last resort. There, Dr. Georges Burou (1910–1987), a French gynecologist, invented and applied the anteriorly pedicled penile skin flap inversion technique in 1956 (Benjamin 1964, 1966; Burou 1973; Pauly & Edgerton 1986; Van Dis 1988). Modern variations of his inversion technique are still in use. From 1958 on, Burou operated on several well-known and very beautiful young transwomen from Le Carrousel club in Paris, including Coccinelle and April Ashley.

By the mid-1960s, centers in the United States were becoming interested in SRS (Benjamin 1964; Burou 1973). This was largely the result of Harry Benjamin's persistence in enlisting competent surgeons to operate on his patients (Benjamin 1966; Pauly & Edgerton 1986).

In 1966, surgeons at the Johns Hopkins Medical Center began performing a limited number of male-to-female (MTF) SRS operations at its new gender identity clinic. Announcement of the Johns Hopkins Clinic confirmed that Benjamin was the world's foremost authority on transsexualism, as did a textbook he authored, *The Transsexual Phenomenon* (Benjamin 1966). Shortly after the first sex reassignment procedures were performed at Johns Hopkins,

hospitals at Stanford, Chicago, and Colorado followed suit (Laub & Fisk 1974; Pandya & Stuteville 1973).

The surgeons at Johns Hopkins initially used partial-thickness skin grafts to line the neovaginal cavity, but later used penile skin, applied as a full-thickness skin graft, much as the technique employed in Copenhagen. The *posteriorly* pedicled penile skin flap inversion technique for vaginoplasty—a variation of Burou's method—was introduced by Edgerton and Bull at Johns Hopkins between 1968 and 1970 (Edgerton 1974). Beginning in 1967, the Chicago group used the *anteriorly* pedicled penile skin flap to line the vagina, and scrotal skin to form the labia (Pandya & Stuteville 1973).

In Europe, beginning in the 1970s, the University Hospital of the Free University of Amsterdam became the leading center for medical and surgical treatment of patients with severe gender dysphoria. By the end of the 20th century many centers of excellence employed a multidisciplinary approach for transsexual individuals, providing state-of-the-art treatment, including surgical therapy, for both transwomen and transmen. With the recent increase in number of individuals seeking treatment for gender dysphoria, the quantity and quality of the multidisciplinary teams have substantially increased worldwide, with the largest number of vaginoplasties probably still being performed in Thailand.

Criteria of Male-To-Female Gender Reassignment Surgery

Standards of Care ***for Surgery***

The 7th version of *Standards of Care* (*SOC*) of the World Professional Association of Transgender Health (WPATH) offers flexible guidelines for the treatment of people experiencing gender dysphoria and put forth the following criteria for surgical treatments (Coleman et al. 2012).

For breast augmentation with implants or lipofilling (one referral):

- persistent, well-documented gender dysphoria;
- capacity to make a fully informed decision and to give consent for treatment;
- age of majority in a given country;
- if significant medical or mental health concerns are present, they must be well controlled.

Although not an explicit criterion, it is recommended that transwomen undergo feminizing hormone therapy (minimum 12 months) prior to breast augmentation surgery. The purpose is to maximize breast growth in order to obtain better surgical (aesthetic) results.

For genital surgery, two referrals are recommended and specifically for orchiectomy the following criterion is added to the list above:

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- 12 continuous months of hormone therapy as appropriate to the patient's gender goals (unless hormones are not clinically indicated for the individual). The aim of hormone therapy prior to gonadectomy is primarily to introduce a period of reversible testosterone suppression, before a patient undergoes irreversible surgical intervention.

For vaginoplasty one additional criterion is recommended:

- 12 continuous months of living in a gender role that is congruent with their gender identity (formerly called "real-life experience").

Prior to any surgical procedure, the surgeon should have all medical conditions appropriately monitored, and the effects of the hormonal treatment upon the liver and other organ systems adequately investigated. This is usually done in conjunction with the medical colleagues prescribing the hormones.

Typically, the patient is advised to stop all hormonal therapy at least 2 weeks prior to any surgical procedure; estrogens, in particular, can cause an increased risk of thromboembolic complications.

Experience of Living in an Identity-Congruent Gender Role (the Former "Real-Life Experience")

As mentioned above, the *SOC* only recommend a 12-month experience of living in the identity-congruent gender role prior to a vaginoplasty procedure. The rationale for this additional criterion in the case of genital surgery is based on expert clinical consensus that this experience provides ample opportunity for patients to experience and socially adjust in this desired gender role before undergoing irreversible genital surgery.

Hormonal treatment can greatly facilitate this experience. Transwomen treated with estrogens can realistically expect breast growth, some redistribution of body fat to approximate a female body habitus, decreased upper-body strength, softening of the skin, decrease in body hair, and slowing or cessation of loss of scalp hair. Hormonal therapy, however has no effect on voice, hand, feet, or shoulder dimensions. Also, beard density is not significantly affected by cross-sex hormone administration. Removal of facial hair, via electrolysis, laser, or intense pulsed-light epilation can be an additional manner to facilitate the experience of living in the new gender role. It is a generally safe but costly and time-consuming process. Formal medical or psychological approval for hair removal procedures is not required; it can be initiated whenever the patient deems it prudent. For most patients, 2 years of regular treatment are required to effectively eradicate facial hair.

A number of feminizing surgical procedures may also assist in living the identity-congruent gender role. These can include liposuction of abdomen and waist, reduction rhinoplasty, otoplasty, maxillofacial feminizing surgery (reduction of mandible angles and frontal bossing, genioplasty), and facial

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rejuvenation (face and/or brow lift, and blepharoplasty). None of these feminizing interventions require letters of recommendation from mental health professionals.

A reduction thyroid-chondroplasty can be performed early on, although certain techniques in voice modification and surgery affecting the vocal cords are best postponed until after all other surgery requiring general anesthesia with intubation, in order to protect the vocal cords. However, in the case of too-low voice pitch, living in the female gender role is difficult. In these cases the laryngeal framework surgery (cricothyroid approximation and/or anterior commissure webbing) to elevate the vocal pitch can be done at an early stage.

Facial Feminization Surgery and Voice Surgery

Facial Feminization Surgery

In most human interactions, the face communicates vital social information. First impressions are largely based upon a person's facial features and expressions. A face reflects aspects of one's personality and emotions, and serves as a vehicle to convey verbal and non-verbal communication. The head and face are commonly considered to be the location of the "self." In initial contacts, it is most often the face that provides the cues about the person, including gender. For the transsexual patient, nothing is more important than to appear externally congruent with the internal and emotional self. While many patients undergo surgery to feminize the face, there is a paucity of literature on these procedures (Hage et al. 1997).

Facial form is composed of many elements, including skeletal foundation and the overlying soft tissue. Although defining the bony foundation is of great importance, it is the soft tissue and the skin envelope that is observable and measurable, as it is encompassed within the frame created by hairdo and neck and shoulder configuration. According to Tessier (1987), "Harmony or disharmony does not lie within angles, distances, lines, surfaces, or volumes; they arise from proportion." Indeed, our perception of shape results from the response of light to depressions and prominence, i.e., highlights and shadows. Lines, insofar as shape is concerned, really do not exist, except as edges of a shape; more important than angles and lines are the texture, shape, light, and anatomic units, which are often accentuated with makeup in females. Several authors have investigated the nature of differences between the male and female face. But even measurement of dimensions such as facial height, bitragion width, bitragion frontal arch, and bitragion gnathion arc leads to differing conclusions among authors. And the variations between ethnic groups create more confounding variables, making generalizations impossible.

Farkas (1987) stated that:

> the relatively small average differences between the sexes suggest that, in general, the facial proportions do not differ noticeably between the sexes

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> although some proportion differences in anatomical area sensitive for a visual perception (lips, nose, orbits) may be apparent.

Although the face, like most physical attributes, varies considerably in projection and form, there is an overlap of masculine and feminine forms and few remarkable differences between the two. Yet it is relatively easy to distinguish between female and male faces. Therefore, some basic attributes of what are commonly perceived to be masculine and feminine features have been set forth. These are the standards which facial surgery addresses as part of an overall SRS.

Typically, the female face is oval and heart-shaped with smooth lines, in contrast to the square and angulated male face. Females have a more pointed chin, more pronounced zygomatic processes, less pronounced mandibular angles, and less nasal prominence than males. Additionally, females have a less angular nasal tip. It is generally accepted that female profiles with smaller noses are more aesthetically pleasing. The forehead is quite different in males from females, particularly the areas of the brows and the mid-forehead, and the shape of the skull affects the drape and contour of the skin. Changing the shape of the skull will assist in changing one feature from distinctly male to female. The techniques used and the areas modified are always individualized. Obviously, some MTF transsexual patients have more feminine-appearing features than others have. Typically, when facial feminizing surgery is under consideration, a preoperative computer simulation is generated to provide a preview of the eventual postoperative result.

Forehead

The forehead covers a large portion of the face and is different in males and females. Consequently, the forehead may be one of the most important areas to surgically modify. Spiegel (2011) investigated the determinants of female gender and discovered a strong association between facial femininity and attractiveness more specifically attributed to the upper third of the face and the interplay of the glabellar prominence of the forehead, along with the eyebrow shape and position and the hairline shape and position.

Males have brow bossing, with a flat area in between the bossing, while females tend to have a completely convex skull in all planes. Based on differences in anthropological measurements, the size of the frontal sinus (in the mid-lower forehead above the eyes and nose), and the general contour of the orbits and forehead, three different ways of modifying the forehead shape have been developed. These vary from simple bony contouring to the more complex procedure, wherein the anterior wall of the frontal sinus is placed into a more posterior position, or in combination with filling of the concavity superior to the frontal bossing with bone cement. Orbital rim contouring may be helpful to make the orbit look bigger, and is completed at the same time. If indicated, a bilateral brow lift can be simultaneously performed.

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The female brow is not positioned at the level of the supraorbital rim but just a little above. The female eyebrow has an arch shape with the highest point at one-third laterally, in contrast with the male brow, that is straight. Scalp advancement can reduce the distance from the brows to the hairline, which is on average 5 cm for women, in comparison to 7 cm for men. Forehead and/or scalp advancement is generally performed under general anesthesia, but local anesthesia and sedation can be used in selected cases. The surgical approach to these various procedures is all basically the same, via an incision in the scalp either in front of the hair-bearing area (so the surplus of skin can easily be excised) or within it if no scalp advancement is necessary.

Cheeks

The cheekbones are more prominent in women and malar augmentation makes the face more heart-shaped. Moreover, lack of cheek prominence is not considered attractive. Cheek augmentation is therefore often effective in feminizing the face. Usually this is done with an implant or with soft-tissue filling, but certain bone cuts (zygoma osteotomies) and bone segment repositioning may be useful in some cases. The bilateral partial removal of the buccal fat pads of Bichat at the same time can help to accentuate the cheekbones by creating a sub-malar hollowing.

Nose

The nose is a feature that varies tremendously from individual to individual, and may be quite masculine-appearing. The noses of men are usually larger than those of women and naso-labial and naso-glabellar angles are sharper. If a patient has a thick skin, a significant size reduction can be undertaken. If not, as is often the case in biological males, the contour can still be markedly improved, but there will be a definite limitation to the extent of reduction possible. However, contour changing alone greatly feminizes the basic nasal appearance. In a reduction rhinoplasty mostly dorsum and tip will have to be made smaller and the tip needs to be lifted. The volume of the nostrils can be reduced by alar base excision. Correction of the frontal bossing and tip lifting make the naso-glabellar angle and naso-labial angle more obtuse and more feminine. If a breathing difficulty happens to coexist, this can often be improved at the time of surgery.

Chin

The chin can vary markedly between male and female. The male chin is generally wide and vertically high, while the female chin tends to be more pointed, narrow, and vertically shorter. The chin, therefore, is a significant marker of gender. The chin can be modified in numerous ways to improve facial appearance and feminize the lower face. This may only require a small

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implant or little shaving, but it is often necessary to perform extensive bone cuts, with removal of excess of bone and repositioning of the chin to make the chin shorter and narrower. Modifications to the chin will depend on individual anatomy of the patient and the desired outcome.

Angle of the Mandible

Males tend to have a more obvious mandible angle, with thicker muscles and resulting fullness, than females. The angle contour in the male is usually due to a heavy masseter muscle and, as a result, a lateral and posterior flaring of the bony angle occurs. The female tends to have a smaller muscle with a more gradual curve or even a straight line along the lateral border from the posterior border of the mandible to the chin. Modifications of the lower face can reduce this obvious aspect of masculinity, thereby creating a feminine appearance. This lower-jaw-contouring procedure is completed under general anesthesia through incisions in the mouth, and usually does not require external skin incisions. The masseter muscle is reduced on its internal surface, i.e., the portion adjacent to the bone. The bone is then significantly reduced laterally, softening the bony angle. When there is a significant mandibular angle present, the angle is osteotomized to give this area a more rounded and smoother appearance. Botulin toxin can also be used to decrease the volume of the masseter muscle.

Upper Lip

Lip lift is regularly used in facial feminization. Its aim is to shorten the upper lip in the area between the alar bases of the nose, making the maxillary tooth crowns more visible. Also techniques making the upper lip more voluminous can help in making the face look more feminine. This can be done by fillers, but the use of dermis grafts has few complications. The dermis graft can be harvested from the coronal flap.

Orthognatic Surgery

Using the Le Fort 1 and bilateral sagittal ramus osteotomy, a combination of feminizing effects can be obtained. A clockwise rotation of the bimaxillary complex with posterior impaction of the maxilla gives more volume to the midface, making the face look rounder. It also makes the gonial angles more obtuse, makes the chin less pronounced, and gives more show to the maxillary tooth crowns.

Hair Transplantation

Hair transplantation, or scalp shifting, is very helpful in transwomen who have considerable balding. There are many ways to approximate a female hair pattern. Major procedures like scalp flap or tissue expansion may be required in some

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cases but, more often, plugs or micro-grafts are employed. Scalp reductions are useful in certain individuals. For those with extensive baldness, there is no choice but to use a hairpiece.

Chondrolaryngoplasty and Voice Surgery

The secondary sex characteristics of the larynx with its vocal function remain a major obstacle to achieving gender congruency for many. Unlike hormonal therapy for transmen, estrogen does not have any substantial or lasting influence on voice pitch, and speech therapy alone often does not produce satisfactory results. Even after transition, an individual may be identified as a man because of voice, most often on the telephone. This can cause social and psychological problems. Surgical procedures to raise the patient's voice pitch are performed with the aim of assisting social integration, and can greatly improve self-esteem in some cases.

Various authors have described operative techniques to raise voice pitch. Basically, this can be achieved by reducing the vibrating vocal cord length (shortening the vocal cords) or increasing the vocal cord tension. The most frequently used technique is the one described by Isshiki (1989). In this technique, the cricoid cartilage is approximated to the lower edge of the thyroid cartilage, causing an increase in vocal cord tension. The cricoid and thyroid cartilages are then fixed to each other with sutures. A modification consists of twisting the fixing wire sutures over titanium, or absorbable miniplates (Neumann et al. 2002). This obviously eliminates the possibility of rupture of cartilages or loosening of the sutures over time.

While this technique extends the vocal cords, it does not cause a narrowing of the glottis. This obviates the necessity of future operations under intubation anesthesia where placement of the tube might be difficult due to a surgically narrowed glottis.

When choosing between local and general anesthesia, the advantage of local anesthesia is that acoustic checking of the voice rise intraoperatively is possible, and thus, over-approximation can be avoided. However, since most patients want the maximum rise, many surgeons perform this procedure using general anesthesia.

A reduction of the prominent thyroid cartilage can be performed in the same procedure. During this intervention, the thyroid cartilage is exposed, perichondrial flaps are raised, and a resection of the upper limit of the thyroid cartilage is performed. A mild, transient voice weakness can be observed postoperatively, and lasts a few weeks. This is probably due to prolonged edema. According to literature, surgical outcomes of voice pitch raising are very good, and the cosmetic benefit of the reduction of the Adam's apple contributes greatly to the patient's psychological well-being (Wolfort et al. 1990).

If cricothyroid approximation is not resulting in sufficient raise of voice pitch, anterior commissure webbing is performed to reduce the length of the vibrating vocal cord, which provides an additional feminization of the voice.

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Figure 14.1 Breast augmentation with prostheses: preoperative view.

Breast Augmentation

Introduction

For most transwomen, breast augmentation (or breast "reconstruction") greatly increases subjective feelings of femininity. Mammoplasty provides a more feminine profile, facilitating adjustment. In a prospective, non-comparative, cohort study it has been shown that the gains in breast satisfaction, psychosocial well-being, and sexual well-being after transwomen have undergone breast augmentation are statistically significant and clinically meaningful to the patient shortly after surgery as well as in the long term (Weigert et al. 2013). The presence of breasts significantly increases the factors involved in passability (Figures 14.1 and 14.2). The augmentation mammoplasty may be performed at the same time as genital surgery, or as a preliminary or subsequent procedure.

Breast Development After Hormonal Therapy

While some breast formation occurs after hormonal therapy, for many, it is insufficient. Unfortunately there are no studies looking in detail at what is the optimum delay after start of hormonal treatment. As mentioned above, the current version of the WPATH *SOC* (version 7) does not explicitly indicate a minimum period of hormone therapy that must be completed before breast surgery may be performed. However, most surgeons recommend a 12-month period of feminizing hormone therapy prior to breast augmentation surgery in order to maximize breast growth and obtain better surgical (aesthetic) results.

Mammogenesis in transwomen receiving estrogens follows a pattern similar to female pubertal mammogenesis, as described by Tanner (Marshall & Tanner 1969). As breast development, it is not exclusively dose-responsive—67–75%

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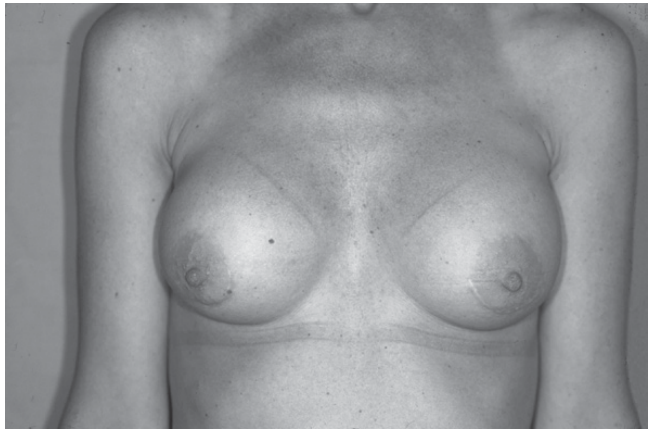

Figure 14.2 Breast augmentation with prostheses: postoperative view.

of transwomen require an augmentation mammoplasty (Kanhai et al. 1999a) because hormonal treatment only results in softly pointed breasts, as seen in young girls, or the small conical form seen in young adolescents (Tanner stage 2 or 3).

Surgical Techniques

Since breast prostheses are implanted in transsexuals with "young adolescent" breast development, the patient should be informed that the complex feminine form and age-related changes of the breast cannot be imitated by using symmetric hemispherical prostheses. Therefore, the result of an augmentation mammoplasty in a transwoman with minimal hormone-induced mammogenesis may be poor (Kanhai et al. 1999b).

Other anatomical differences, which should be taken into consideration in transwomen, are the wider male chest; a stronger pectoral fascia and a more developed pectoralis muscle, and a smaller dimension of nipple and areola. Usually a larger volume of breast prostheses is chosen by transwomen than that chosen for breast augmentation by a female patient, but even with a larger prosthesis, it is often impossible to avoid an abnormally wide cleavage between the breasts. The nipple areola should always overlie the prosthesis centrally and a very medial position of these prostheses could result in a divergent nipple position with an unacceptable breast appearance (Laub & Fisk 1974). In our personal experience we have used lipofilling as an adjunct to make the prosthesis less visible and palpable, as well as to narrow the wide cleavage between the breasts. Lipofilling is a technique where fat is harvested by liposuction of the abdomen or thighs. Subsequently the fat is prepared as described by Coleman and Saboeiro (2015) and injected in the subcutaneous plane. In transwomen

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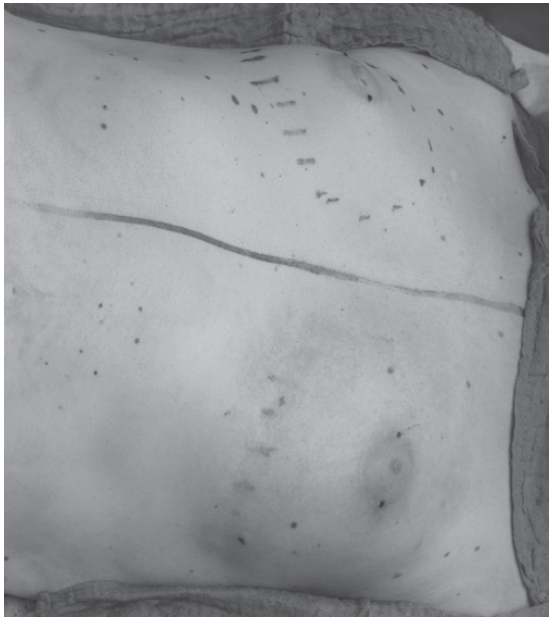

Figure 14.3 Lipofilling (left breast only here) can be used for a moderate augmentation without prostheses.

who already have some breast volume due to hormone treatment, lipofilling can be a good option to provide a moderate augmentation of the breast, therefore avoiding the need for an implant (Figure 14.3). Patients should be informed that a variable percentage of the injected fat is resorbed.

Despite some sexual differences in chest wall and mammary anatomy, the implantation of mammary prostheses is not essentially different from breast augmentation in a female patient, except that, usually, larger prostheses are used. The same choices apply as to the kind of prostheses, the position of the pocket, and the surgical approach. Patient and surgeon can choose between a silicone gel-filled prosthesis and a saline-filled prosthesis. In most cases, a textured prosthesis is chosen to reduce the chance of capsular contraction. When a more cohesive gel-filled prosthesis is chosen, it can be a round prosthesis or a so-called anatomical prosthesis, resulting in additional filling of prominence in the lower part of the breast.

The incision can be made axillary, inframammary, or even periareolar, although the latter is less popular in transwomen because of the smaller size of the areola. If an inframammary incision is used, it should be positioned lower than the preoperative inframammary fold, as the distance between the inferior areolar margin and the inframammary fold will expand after augmentation mammoplasty, likely due to the recruitment of the inframammary or even abdominal skin (Kanhai et al. 1999a).

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The pocket for the prosthesis can be created behind the glandular tissue or behind the pectoralis muscle. Some authors (Kanhai et al. 1999a) recommend implanting the prostheses in a subglandular position. This is especially indicated in patients who have more subcutaneous and glandular tissue to start with (Tanner stage 4 or 5). The surgical procedure is easier to perform and less painful. Many surgeons, however, prefer to put the prostheses in a retropectoral position. In this case, the lower portion (as well as part of the medial origin) of the pectoralis muscle should be detached from the thoracic cage (Monstrey et al. 2001). In the retropectoral position, the prosthesis is covered with more soft tissue (important in the case of thin patients), and a lower risk of capsular contraction has also been reported.

Complications

Kanhai et al. (1999b) reported the main (but rarely occurring) complications after breast augmentation: hematoma, symmastia, capsular contracture, a decreased sensation in the nipple and/or part of the breast, leakage of the prostheses (more obvious in saline-filled prostheses than in cohesive silicone gel-filled prostheses), and malposition of the prostheses. Although it is very rare in these patients, mastopexy can be the treatment of choice to correct (substantial) mammary ptosis, but usually an augmentation is sufficient to fill out the (slightly) ptotic breasts.

Galactorrhea is another rare condition that can occur pre- or postoperatively. It requires an extensive hormonal evaluation with particular attention to the pituitary gland. Apart from hormonal causes, excessive prolactin secretion causing galactorrhea may also result from a peripheral stimulus such as breast manipulation or intercostal nerve stimulation. Galactorrhea in the latter case is associated with chest incisions or inflammation of the chest wall and thus may also be caused by mammary implants. In many patients, however, no cause for the galactorrhea can be found and the condition remains idiopathic.

Postoperative follow-up is mandatory in all patients undergoing breast augmentation. Gooren et al. (2013) performed a cohort study documenting the occurrence of breast cancer in 2,307 transgender persons with an exposure to cross-sex hormones between 5 and 30 years and reported 10 cases of breast cancer in transwomen. All patients received oral estrogens for prolonged periods to maintain secondary female characteristics. Three out of these 10 were not estrogen-dependent breast carcinomas. The study by Gooren et al. suggested that cross-sex hormone administration does not increase the risk of breast cancer development in transwomen. Breast carcinoma incidences were comparable to male breast cancers, and thus lower than in the female population. However, the historical use of cross-sex hormones may have been too short for malignancies to develop. Therefore good screening and follow-up are imperative. Moreover, since breast exams are also very well accepted by transwomen, transgender persons should be encouraged to participate in relevant

cancer screening protocols, which for breast cancer screening are the same as for cisgender women (Weyers et al. 2010).

Routine preoperative investigation of family history is imperative. Screening for genetic predisposition (such as *BRCA* mutations) should be considered in patients with multiple breast and/or ovarian cancers within their family (often diagnosed at an early age); two or more primary breast and/or ovarian cancers in a single family member; and/or cases of male breast cancer within their family. Psychological counseling about bilateral prophylactic mastectomy and consecutively primary reconstruction with either autologous tissue (such as a deep inferior epigastric perforator flap) or prosthesis should be offered in patients with a genetic predisposition for breast cancer (Colebunders et al. 2014).

Orchiectomy

General Considerations

Orchiectomy can be performed simultaneously with a vaginoplasty or as a first-stage procedure prior to the vaginal reconstruction. If an orchiectomy is performed as a preliminary procedure, it will not compromise the possibility of a vaginoplasty at a later stage, as the testicles can be accessed via a short 5-cm incision at the raphe, leaving very little scar tissue. Androgen-blocking treatment can usually be stopped or reduced after the orchiectomy. In most countries an orchiectomy is mandatory for a transwoman in order to legally become a woman, but this may change in the near future as several countries no longer require any surgery at all.

Reproductive Options

Attention should be given to reproductive possibilities and restrictions after orchiectomy. A majority of transwomen has been reported to desire having children (Wierckx et al. 2012). Transwomen should be given the option of sperm preservation in sperm banks, prior to initiating hormones. If patients have already initiated hormones, there are data that report eventual recuperation of sperm count after a hormone-free period. So these patients can be given the option to stop hormonal therapy temporarily to bank their sperm. There is a reasonable chance of a live birth from transwomen's sperm storage, in contrast to transmen, who have approximately a 4–13, 6% chance of a live birth from cryopreservation of their gametes (Richards & Seal 2014).

Vaginoplasty

Introduction

As affirmed by Karim et al. (1996), the goal of genital reassignment surgery in MTF transsexuals is to create a perineo-genital complex as feminine in

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appearance and function as possible and free of poorly healed areas, scars, and neuromas. The urethra should be shortened in such a way that the direction of the urinary stream is downward in the sitting position and it should be free of stenosis or fistulas. The neovagina should, ideally, be lined with moist, elastic, and hairless epithelium. Its depth should be at least 10 cm and its diameter 30 mm. The sensation should be sufficient to provide satisfactory erogenous stimulus during sexual intercourse. Ideally, all these requirements should be met without major surgical intervention necessitating long and distressful postoperative treatment, and addressing them should not create new lesions or donor area malfunction.

The major steps in a vaginoplasty are an orchiectomy (if not previously performed), amputation of the penis, creation of the neovaginal cavity, the lining of this cavity, reconstruction of a urethral meatus and, finally, construction of the labia and clitoris.

In order to obtain a functional and aesthetic outcome, most authors advise to construct a wide and deep vaginal cavity, and to perform a near-complete resection of the corpus spongiosum, an eversion of the urethral mucosa, and the construction of clitoris/clitoral prepuce, labia minora/majora. Several refinements of vaginoplasty (mostly using the inverted penile-scrotal skin flap technique in combination with skin grafts) have been described (Karim et al. 1995; Selvaggi et al. 2005). These include preoperative epilation of the area at the base of the penis and posterior scrotum; preoperative bowel preparation; the use of a drape with a rectal condom; blunt dissection of the vaginal cavity; and the use of double-silicone prosthesis to create and maintain a vaginal cavity of adequate dimension.

Vaginal Lining

Methods for lining the neovagina can be classified into six categories: (1) non-genital skin grafts; (2) penile or scrotal skin grafts; (3) penile-scrotal skin flaps; (4) non-genital skin flaps; (5) pedicled intestinal transplants; and (6) recent developments.

Non-Genital Skin Grafts

Laub and Fisk (1974) reported the first series of transwomen in whom a *split-skin* graft pulled over a plastic mold was applied in a one-stage vaginoplasty. The use of a *full-thickness* skin graft, harvested from the region of a (mini) abdominoplasty, has been described by Hage and Karim (1998). It is generally known that full-thickness skin grafts contract less than their thinner counterparts. Abdominal skin grafts are usually used if there is insufficient penile and scrotal skin available or if transwomen request an abdominoplasty procedure. The advantages of non-genital skin grafts are that they are non-hair-bearing, and they carry a low risk of complications (Hage 1995). The disadvantages include the tendency of the skin graft to shrink (postoperative

daily dilation is required), suboptimal sensation, and the absence of any natural lubrication (McGregor 1989).

Penile or Scrotal Skin Grafts

Fogh-Andersen was the first to report the use of a full-thickness skin graft harvested from the *penile* skin to line the neovagina (Fogh-Andersen 1956). The advantage of using penile skin is that it is non-hair-bearing, compared to scrotal skin. However the use of penile skin as a graft for vaginoplasty is rarely, if ever, performed as it is usually preserved to be used as a (pedicled) penile flap undergoing less contraction postoperatively. On the other hand, in most vaginoplasty operations the excess of *scrotal* skin is used as a full-thickness graft to line the deepest part of the vaginal cavity, since the amount of skin provided by the penile skin flap is often insufficient to provide a neovagina of adequate dimensions. This redundant skin must be thinned in order to facilitate the ingrowth of the skin graft and also to eliminate all the hair follicles, avoiding postoperative hair growth in the vagina.

Penile-Scrotal Skin Flaps: The Technique of Choice

As previously discussed, Burou has been credited with inventing the anteriorly pedicled penile skin flap inversion technique, and it became (and still is) the technique of choice for vaginoplasty in transwomen. However, in 1957, Gillies and Millard were the first to report on the use of penile skin as a pedicled flap for vaginoplasty. Several modifications of this technique were subsequently described. These can be classified into the following three groups (Bouman 1989):

1. The inverted penile skin is used solely on an abdominal pedicle as an inside-out skin tube (Eicher 1989; Gillies & Millard 1957); this penile skin flap can be augmented with a small triangular scrotal skin flap to "break" the circular introitus (Bouman 1988; Karim et al. 1995). Variations of this technique are used by most surgeons who perform SRS in transwomen today and this technique is therefore considered "the gold standard in vaginoplasty" (Figures 14.4, 14.5, and 14.6).
2. The pedicled penile skin tube can also be split open to form a rectangular flap which is augmented by a rectangular, posteriorly pedicled scrotal skin flap comparable in size (Jones et al. 1968).
3. The inverted penile skin tube may be applied based on an inferior pedicle (Edgerton & Bull 1970). Perovic et al. (2000) described a modification of the technique wherein a long, vascularized urethral flap is harvested and embedded in the penile skin tube flap. They also described the suspension of the neovagina to the sacrospinous ligament to prevent vaginal prolapse, a complication that is rarely, if ever, experienced by others.

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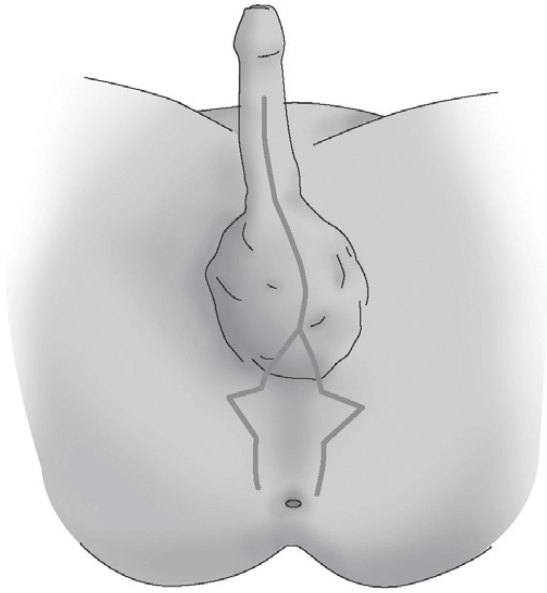

Figure 14.4 Inverted penile skin flap technique with dorsal scrotal flap.

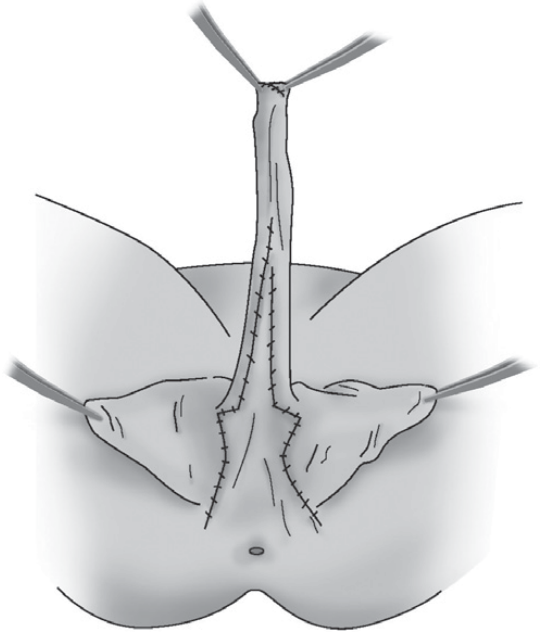

Figure 14.5 Inverted penile skin flap technique after resection of all erectile tissue.

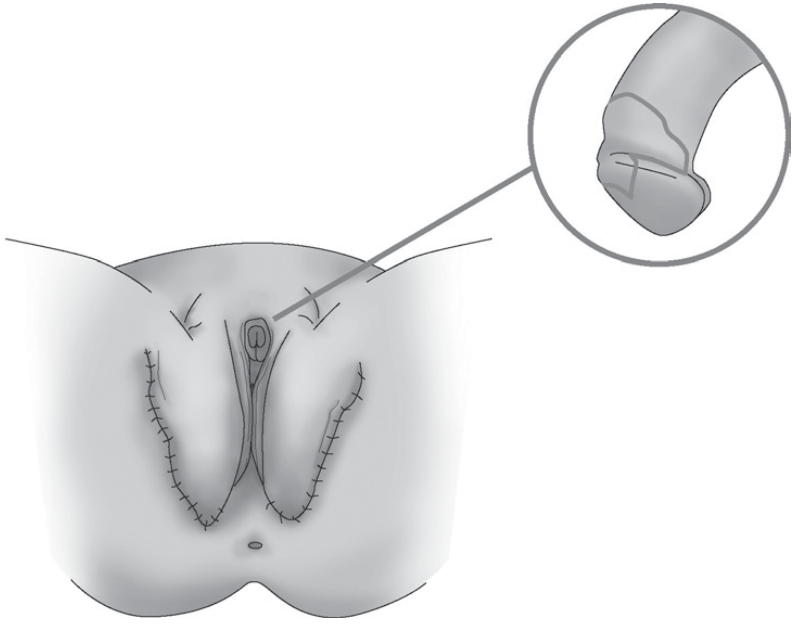

Figure 14.6 Inverted penile skin flap technique: immediate postoperative result with clitoroplasty.

There are several advantages to penile skin flaps. They demonstrate fewer tendencies to contract (McGregor 1989). In the event of inadvertent damage to the rectum, correction is easier, as it is immediately covered with vascularized tissue (Karim et al. 1995). Local innervation is provided and the flap is virtually hairless. Although flaps have much less tendency to contract than grafts, patients are still required to use a dilator postoperatively for 6 months. The disadvantages of penile skin flaps are that a limited amount of penile skin may be available (Van Noort & Nicolai 1993), and that this technique might results in widening of the anterior commissure, which can leave the clitoris more exposed (Bouman 1988; Karim et al. 1995).

Combining an abdominally pedicled penile skin flap with a wide posteriorly based scrotal skin flap produces an ideal anatomically located introitus and favorable dimensions of the neovagina (Van Noort & Nicolai 1993). However, this technique will introduce hair-bearing scrotal skin within the posterior lining of the vagina if epilation has not been performed prior to surgery. Moreover, it leads to a transverse appearance of the vaginal introitus if a wide flap is used (Turner et al. 1978), which is less aesthetically pleasing.

Non-Genital Skin Flaps

In 1980, Cairns and De Villiers reported the use of a medial thigh flap for vaginoplasties in four patients who had previously undergone penile skin

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inversion vaginoplasty with inadequate results. Huang (1995) used two inguino-pudendal flaps, sutured to one another in the midline and then to the penile flap, forming a single large flap. The use of distant free flaps for vaginoplasties in transsexuals has never been reported.

The advantages of using non-genital flaps are that they have less risk of contraction and a reduced period of postoperative dilation. The disadvantages are donor site morbidity and scarring, technical complexity (in some cases the flaps are unreliable) (Wee & Joseph 1989), and their tendency to be bulky as compared to genital skin flaps. This added bulk can decrease the functional dimensions of the neovagina, which is particularly disadvantageous in transwomen, as the male pubic arch is narrower than the female (Karim et al. 1996). Again, these flaps have no natural source of lubrication. Non-genital skin flaps should be reserved as a choice of last resort, after all other options have been exhausted.

Pedicled Intestinal Transfer

Intestinal vaginoplasty is a good alternative technique in cases where insufficient skin is available. A lack of penile and scrotal skin is often present in young transwomen who started hormonal therapy at an early age. Transwomen who had a previous failed vaginal reconstruction with skin flaps and/or grafts can also benefit from this procedure (Kim et al. 2003). A pedicled intestinal transfer can also be used to elongate the vagina in transwomen requiring more depth after a previous vaginal reconstruction.

Both small as well as large intestinal segments have been used for vaginal reconstruction (Bouman et al. 2014). For vaginoplasty with a large intestinal segment, the sigmoid is most commonly the first choice. Where the small intestines are used, the ileum is mainly chosen. Harvest of the bowel can be performed through a median or Pfannenstiel laparotomy, a laparoscopy-assisted laparotomy, or totally laparoscopic. Laparoscopic harvest of bowel has been described by Wedler et al. in 2004 and has been more widely used since. Zhang et al. (2014) showed that laparoscopic-assisted vaginoplasty using pedicled ileum or sigmoid segment are both effective in reconstructing a vagina.

The advantages of using a rectosigmoid transplant are not only the length it provides, but also the texture and appearance, which is more similar to vaginal lining, and of course its natural lubrication (Dalton 1981; Kim et al. 2003). Although the natural lubrication with the production of mucus is usually regarded as an advantage, it may lead to excessive discharge (Hage et al. 1995), especially when ileum is used, compared to colon.

Neovaginal length after an intestinal transfer usually is significantly longer compared to other vaginoplasty techniques. However, if the intestinal segment is taken too long, it can lead to stasis and dehydration of mucus in the deepest portion of the vagina. An intestinal transfer itself has little or no tendency to shrink but dilation remains important to avoid introital stenosis, which is the

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most common reported complication of intestinal vaginoplasty (Bouman et al. 2014; Davies & Creighton 2007).

Bouman et al. (2014) performed a review of the literature focusing on clinical outcomes of intestinal vaginoplasty, including 21 studies. Prevalence and severity of procedure-related complications were low. Diversion colitis (inflammation that occurs in the bypassed colonic tissue related to diversion of the fecal stream) was very rare. Severe complications were incidental and included necrosis of the intestinal segment, necrotizing fasciitis, bilateral lower-extremity compartment syndrome, an intraluminal abscess, and intestinal obstruction (Bouman et al. 2014). The colonic mucosa is thought to be more vulnerable, and hence, more accessible to sexually transmitted diseases, including human immunodeficiency virus (HIV) infection (Hage & Laub 1995). A limited number of cancers in both sigmoidal and ileal grafts have been observed (Schober 2007).

Recent Developments

AUTOLOGOUS BUCCAL MUCOSA

In 2003 Lin et al. were the first to describe vaginoplasty with autologous buccal mucosa as graft material in eight cases of vaginal agenesis, such as Mayer–Rokitansky–Küster–Hauser syndrome (MRKHS). They used buccal mucosal grafts of approximately 2.5×7 cm² in size and sutured them into a newly created vaginal cavity (Lin et al. 2003). Later, Li et al. (2014) modified this technique by using micro-grafts of the buccal mucosa, minimizing donor site morbidity, and enlarging the possible surface area to be grafted. Dessy et al. (2014) reduced donor site morbidity even further by taking a 2-cm² full-thickness oral biopsy and culturing it into fully differentiated mucosal tissue. They used these cultured autologous oral epithelial cells for SRS in transwomen in a three-step procedure: first, they took the mucosal biopsy; second, they created a vaginal cavity with autologous mucosal lining; and third, they constructed the clitoris and labia using the glans of the penis and the scrotum. Although autologous mucous tissue is not yet widely used in SRS, it might become a treatment of choice in the future as it has potential advantages. Grafted mucosa has a high survival rate and low incidence of contracture. Moreover mucosa has a secretory function, which can play a role of lubrication during sexual intercourse, reducing the rate of dyspareunia.

ACELLULAR DERMAL MATRIX

To date there are no reports using acellular dermal matrix as vaginal lining in transwomen. However its use has been described for vaginal reconstruction in patients with MRKHS. Ding et al. (2015) reported successful use of acellular porcine small intestinal submucosa graft in MRKHS patients. In future it may become a choice for transsexual patients who have previously undergone

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Figure 14.7 Vaginoplasty: early postoperative result (2 weeks) with still-swollen smaller and greater labia.

penectomy and orchiectomy. The main drawback of using acellular dermal matrix, however, is the high cost.

CLITORO-LABIOPLASTY (VULVOPLASTY)

In order to achieve the physiologic and aesthetic equivalent of female external genitalia, it is imperative to create labia majora and minora, a clitoris, and a clitoral hood (Figures 14.7 and 14.8). The creation of the labia majora is dependent on the use of either a penile flap or a graft, and the amount of scrotal skin remaining after resection. Usually, creating aesthetically acceptable labia majora is not a problem. However, secondary corrections may be needed, since changes in appearance may occur during the first year postsurgery (Hage et al. 2000). A common secondary correction is symmetrization of the labia majora and sometimes a commisuroplasty with recreation of the anterior commissure covering the neoclitoris (Hage et al. 2000; Selvaggi et al. 2005).

Little has been written specifically about the labia minora. Perovic et al. (2000) described using the base of the penile skin to form the labia minora,

Figure 14.8 Vaginoplasty—result after 3 months.

which are then sutured to the deepithelialized area of the neoclitoris. Thus, the neoclitoris is hooded with labia minora. We have used penile foreskin (in continuity with the glans flap for clitoral reconstruction—see below) in order to construct the labia minora and the clitoral hood.

The first person to describe the construction of a neoclitoris was Brown, in 1976. He reported the creation of a functional clitoris using the reduced glans, which remained attached to its dorsal penile neurovascular pedicle (Brown 1976, 1978). The high percentage of clitoral necrosis (33%) that Brown reported prompted some surgeons to search for new techniques. These have included the free composite graft of the tip of the penile glans to cover the shortened dorsal neurovascular bundle, a small bud of corpus cavernosum covered by penile skin, and the corpus spongiosum as the vascular pedicle of the neoclitoris, preserving the glans (Hage et al. 1994; Malloy et al. 1976; Meyer & Kesselring 1980; Rubin 1980). At present, most surgeons performing a clitoroplasty in transsexual patients use the dorsal portion of the glans penis in a horseshoe or W-pattern with the dorsal neurovascular pedicle (Eldh 1993; Giraldo et al. 2004; Karim et al. 1995; Rubin 1993; Selvaggi et al. 2005). Dissection of the pedicle can be performed in a plane just above the tunica albuginea of the corpora cavernosa, or in a plane just posterior to this tunica. The latter is a more rapid dissection, but may result in a bulky pedicle and thus an elevated mons pubis.

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The clitoral hood and the labia minora can be constructed using a thin inner layer of penile foreskin, which is harvested in continuity with the glans flap. This is the only manner in which the very delicate features of the anterior commissure of the vulva, where the clitoris is located and where the labia minora start from the clitoral hood, can be reconstructed in a natural way (Figures 14.9, 14.10, and 14.11).

The neoclitoris has the ability to swell and cause a climax on erogenous stimulation. In order to achieve swelling of the labia minora as well, we have designed an extended clitoroplasty in which two lateral extensions of the glans penis are placed in the base of the labia minora (unpublished data). Anatomically, this extended neoclitoris mimics better the female clitoral apparatus. The extensions simulate the female corpora cavernosa—cylindrical organs, made of cavernous erectile tissue, which are the "hidden" part of the clitoris (Puppo 2011).

Selvaggi et al. (2005) described the use of the penile urethra to construct the region between the urethral opening and the neoclitoris. The urethra is incised longitudinally along its ventral aspect, folded open, and sutured just inferior to the neoclitoris. This produces a natural appearance, in both color and texture.

Postoperative Care

When an anteriorly pedicled penile skin flap technique has been used in combination with a posterior scrotal flap and skin grafts, the patient usually remains in bed for 4–5 days, with the dilator firmly in place. Fractionized heparin is provided subcutaneously.

After 5 days, the dilator is removed, and the patient is allowed to ambulate. The neovaginal cavity is cleansed daily with an iso-Betadine solution and the patient starts to dilate according to a strict protocol. The following day, the urethral catheter is removed and spontaneous voiding is started.

The patient is usually discharged on the seventh or eighth postoperative day, and is instructed in the care of the neovagina. This consists of progressive removal of the dilator and irrigation of the vaginal cavity with iso-Betadine. The period of time that the dilator remains out is gradually increased over the following 3–6 months. Later, if the patient is having regular sexual intercourse, no further dilation is required. Otherwise, routine dilation should continue once or twice per week, especially if a full-thickness skin graft has been used in addition to the pedicled penile skin flap.

Complications

Although the surgical techniques for vaginoplasty have evolved and improved significantly, patients have to be informed that both medical and surgical treatments are rarely perfect. Revisional surgery is sometimes required to optimize aesthetic results.

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Figure 14.9 Vaginoplasty—result after 3 months with a detail of the clitoral hood.

Figure 14.10 Long-term result vagino-clitoroplasty.

Figure 14.11 Long-term result vagino-clitoroplasty.

Early (but rare) postoperative complications include bleeding (usually resolved by applying some pressure), lower-extremity compartment syndrome, infection, or impaired wound healing. One specific complication related to the vaginoplasty procedure is the development of a rectovaginal fistula, as the vaginal cavity needs to be created between the prostate urethra anteriorly and the rectum posteriorly. The rectum has a rather thin wall, and care must be taken to avoid a perforation. If a rectal injury occurs during the dissection of the neovagina, a double-layer closure should be performed. This usually heals without problem since a preoperative bowel preparation is routinely performed.

Possible late complications include stenosis of the new urethral meatus, which is rare with the eversion flap of the urethral mucosa.

Lifelong vaginal hygiene and dilatation are recommended, especially in operated transwomen undergoing limited or no penetrative sex. Most patients are able to reach an orgasm after the operation (clitoral in most cases), and despite the fact that they often experience some moistening of the vulva during sexual excitation, most transwomen require lubrication for sexual intercourse. Until the first uterine transplantation in a transwoman, pregnancy is of course not possible.

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15 Female-to-Male Gender Reassignment Surgery

Britt Colebunders, Salvatore D'Arpa, Steven Weijers, Nicolaas Lumen, Piet Hoebeke, and Stan Monstrey

History of Transmen Surgery

In surgery, particularly in plastic and reconstructive surgery, it is generally easier to resect tissue than to add it. This explains why a phalloplasty is considered a much more complex surgical procedure than a penectomy, with or without vaginoplasty. It also explains why so little is known about the history of penile reconstruction in transmen. Also, virtually no data exist on the number of transgenders who underwent mastectomy, hysterectomy, and/or bilateral salpingo-oophorectomy (BSO) to relieve severe gender dysphoria prior to the 20th century.

The term "phalloplasty" was first used in 1858 by Sprengler to indicate the reconstruction of the integument after décollement (separation of the superficial tissue layers) of the penis (Biemer 1988a). Bogoras, the first to report on the reconstruction of the entire penis, labeled his procedure "penis plastica totalis" (Bogoras 1936). He was also the first to use a single abdominal tube, a technique that was later applied by others. Subsequently, "phalloplasty" was used to describe penile reconstruction.

Following World War II, some leading plastic surgeons showed an interest in the penile reconstructive procedure. In 1948, McIndoe improved the abdominal tube flap by constructing a neourethra while raising the pedicle tube, employing an inlay skin graft. Maltz (1946) and Gillies and Millard (1957) popularized the technique when they added a costal cartilage graft as a rigidity prosthesis. Gillies was the first to report the use of this technique in a transsexual patient. The Stanford team (Biber 1979; Laub et al. 1989) refined the procedure, tubing an infra-umbilical abdominal flap outside-in in order to create a skin-lined tunnel as a future urethral conduit. This method reduced the number of stages previously required for phalloplasty.

Snyder described a phalloplasty technique incorporating a preconstructed superficial skin-lined conduit for intersex patients employing a single-pedicled infra-umbilical skin flap (Snyder & Browne 1977). Hester performed a penile reconstruction in one stage using a vertical, superficial inferior epigastric artery flap with a subcutaneous pedicle, in a male born with ambiguous genitalia (Hester et al. 1984). However, after McGregor

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introduced the groin flap in 1972 (McGregor & Jackson 1972), Hoopes (1974) commented, "the groin flap may prove to be the method of choice for phallus reconstruction." Orticochea (1972) used a gracilis myocutaneous flap in a five-stage phalloplasty procedure, and claimed that it produced cosmetically and functionally superior results. The Norfolk team also used a unilateral gracilis myocutaneous flap for phalloplasty (Horton et al. 1977). Sometimes, a combination of flaps was used. Exner (1992) implanted a ridigity prosthesis in a rectus abdominis muscular flap and used bilateral groin flaps to cover the neophallus.

More recently, however, microsurgical free flaps have been considered state of the art in penile reconstruction (Hage et al. 1996; Monstrey 2009). The most frequently used free flap is the radial forearm flap, or Chinese flap, first described by Song et al. in 1982. However, different flaps have been described since then (Felici & Felici 2006; Hage & De Graaf 1993; Santanelli & Scuderi 2000). The fact that so many techniques for penile reconstruction still exist is evidence that no technique is considered ideal.

Criteria for Sex Reassignment Surgery

Surgical therapy in transmen can consist of facial masculinization, surgical lowering of the voice pitch (rarely indicated after hormonal therapy), subcutaneous mastectomy (SCM), hysterectomy, and/or BSO, vaginectomy, reconstruction of the fixed part of the urethra (if isolated, metoidioplasty), scrotoplasty, phalloplasty, insertion of testicular prostheses, and/or erection prosthesis. However, the two major surgical interventions are SCM and phalloplasty with testicular/erection prosthesis.

Standards of Care

The seventh version of *Standards of Care* (*SOC*) of the World Professional Association of Transgender Health (WPATH) offers flexible guidelines for the treatment of people experiencing gender dysphoria and puts forth the following criteria for surgical treatments (Coleman et al. 2012).

Criteria for mastectomy and creation of a male chest are:

- persistent, well-documented gender dysphoria;
- capacity to make a fully informed decision and to give consent for treatment;
- age of majority in a given country;
- if significant medical or mental health concerns are present, they must be well controlled.

For "internal" genital surgery (hysterectomy and salpingo-oophorectomy) the following criterion is added to the above list:

- 12 continuous months of hormone therapy as appropriate to the patient's gender goals (unless hormones are not clinically indicated for the individual). The aim of hormone therapy prior to gonadectomy is primarily to introduce a period of reversible estrogen suppression, before a patient undergoes irreversible surgical interventions.

For "external" genital surgery (metoidioplasty or phalloplasty), one additional criterion is recommended:

- 12 continuous months of living in a gender role that is congruent with their gender identity.

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Gender Binaries

Until recently medical professionals have considered gender to be binary. A person was considered to be either man or woman, nothing in between. This idea of dichotomy forced transgenders to seek out therapy to correctly align their bodies with the opposite of their biologic gender. Partial surgeries were thought to create abnormal bodies and even a "freakish" phenomenon. However, the concept of gender fluidity has existed probably since the beginning of time. The medical profession has been catching up with this concept of gender fluidity. Version 7 of the *SOC* focuses more on gender variance, considering gender as a spectrum instead of a dichotomy. Yerkea and Mitchella (2011) showed in a cohort study that some participants were satisfied with their gender identity after chest surgery alone. They concluded that genital surgery is not a necessary final step of transition for all transmen. A person can be perfectly satisfied with his body somewhere in the spectrum between man and woman. It is obvious that the medical world nowadays has a more fluid view on gender identity beyond the binary. However, empirical data on genderqueer individuals and their quality of life are still lacking today.

Referral Letter

The WPATH *SOC* state that, in order to proceed with any type of genital surgery ("internal" or "external"), two referrals from qualified mental health professionals who have independently assessed the patient for suitability and readiness are required, while for breast/chest surgery, only one letter is required. Recently, several articles (Bouman et al. 2014; Rachlin et al., 2010; Weiss & Green 2014) have questioned this recommendation for two referrals in order to undergo genital surgery and especially in the case of "internal" genital surgery (hysterectomy and salpingo-oophorectomy). It has been demonstrated that, especially for a hysterectomy, the majority of patients in the community will not have two letters (unless maybe when evaluating for a phalloplasty at the same time) (Rachlin et al., 2010; Weiss & Green 2014). Weiss and Green (2014) suggest in a letter to the editor moving the WPATH guidelines to a single

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mental health letter requirement for hysterectomy, helping patients face fewer barriers to care. This recommendation is supported by Bouman et al. (2014). In their paper they also advocate a single signature of approval from a qualified mental health professional before genital reconstructive surgery, if sufficient safeguards are in place, including assessment within a multidisciplinary team. We have evolved to a more "patient-centered" medicine where it should be simply accepted that a transperson who seeks gender reassignment surgery for a persistent, well-documented gender dysphoria and has taken hormone treatment for 12 continuous months has had enough time to reflect about the benefits and risks of the surgery and can decide by himself if genital surgery is required or not. In this perspective it is difficult to sustain the rationale for the two written qualified mental health professional opinions rule, concerning the prevention of harm to the patient (Bouman et al. 2014).

It could be argued that for external genital surgery still two letters are appropriate, but less imperative for internal genital surgery (BSO and hysterectomy). Adequate preparation and assessment, and this especially within a multidisciplinary team, are much more important than the simple safety measure of requiring two signatures for genital surgeries.

Facial Masculinization Surgery

In most aesthetic operations, patients like to improve their looks but above all continue to look like themselves. In facial feminization and masculinization surgery, the patient wishes to change dramatically. As described in Chapter 14 about facial feminization surgery, the face communicates vital social information. In initial contacts, it is most often the face that provides cues about the person, including gender. For transpeople, nothing is more important than to appear externally congruent with the internal and emotional self. In order to avoid immediate identification as transgender it is essential that facial features are adjusted in such a way that the face will be recognized as belonging to, in this case, the male gender. The male facial skeleton is larger, squarer and more angulated with sharp lines and a strong jaw. Facial masculinization procedures in transmen are exceedingly less common than facial feminization procedures in transwomen. Consistent with these observations, very few studies focusing explicitly on these procedures are found during a literature search. Douglas Ousterhout has published some articles about facial masculinization procedures in male patients, concluding that the areas generally to be considered in masculinization of the male face are the forehead, chin, and angle of the mandible (Ousterhout 2011). These techniques could also be used for facial masculinization surgery in transmen. Like in phalloplasty, these procedures require tissue to be added instead of resected.

Forehead

The forehead is one of the most important areas to surgically modify. Males have brow bossing, with a flat area in between. It is the bossing anterior to both of the frontal sinuses but also at the superior lateral orbital angle that makes

the male forehead look as it does. The supraorbital rim can be augmented with methyl methacrylate by a coronal approach. The methyl methacrylate can be contoured easily. The most important thing is to determine preoperatively with the patient how much augmentation he wants.

Angle of the Mandible

In males the angle of the mandible is more pronounced vertically and posteriorly. Also the lateral flaring makes the angle of the mandible look masculine. Augmentation of this region can thus be desired in transmen. There are two methods for augmenting the mandibular angle. The easiest and most common method is to use a mandibular angle implant. These implants can be custom-made and are placed through an intra-oral approach avoiding visible scars. The other technique is to use a bone graft. The bone graft can be calvarial or iliac crest and is placed in between the outer cortex of the mandibular angle and the spongious bone after sagitally splitting the mandibular angle. This prevents resorption of the bone graft. This can be the result if the bone graft is placed in between the lateral cortex and the masseter muscle. The thickness of the bone graft depends upon the desired augmentation.

Chin

The chin in males is vertically higher and laterally there is a fullness that makes the chin more masculine. Also a more anterior prominence is common in men. When the chin is small in whatever dimension, augmentation can be performed as desired. The desired vertical augmentation is very difficult to obtain with an implant. Osteotomies of the chin can augment the chin in vertical, anterior, and lateral directions. The advancement of the chin through an osteotomy can also have a substantial effect on the submental tissues and the submental cervical angle. Chin implants will not have this effect as the bony chin itself is not advanced. After repositioning of the bony segments, they are held in place with multiple plates and screws. The space created by the expansion and repositioning of the bone can be filled with hydroxyapatite granules.

Cheekbones

Prominent cheeks generally are attractive in both genders. So malar augmentation may be a desirable procedure. It is not necessary for increasing masculinization but it can be an individual desire.

Subcutaneous Mastectomy

Introduction

Because hormonal treatment has little influence on breast size, the first (and, arguably, most important) surgery performed in transmen is the creation of a

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male chest by means of SCM. This procedure allows the patient to live more easily in the male role (Eicher 1992; Hage & Bloem 1995; Lindsay 1979) and thereby facilitates the "real-life experience," which is a prerequisite for external genital surgery.

A large body of literature concerning the optimal technique for performing SCM exists, but most of it focuses on women with breast disease or men with gynecomastia. There is a paucity of information regarding removal of the breasts in transmen.

Obviously, the male chest and the female chest are anatomically different (Hage & Kesteren 1995). The female chest has excess skin, excess glandular tissue, and a surrounding surplus of subcutaneous fat. With regard to the inferior confinement of the breast, in the female, the inframammary fold is well defined. In the average male, the chest does not show an inframammary fold and the inferior margin of the pectoralis muscle (often somewhat squared by rudimentary breast tissue and nipple) represents the dim inferior margin of the chest. The importance of obliterating the inframammary fold while contouring the male chest has been stressed by several authors (Edgerton 1984; Gilbert et al. 1988).

From a purely anatomical viewpoint, SCM in transmen is virtually identical to that of mastectomy for breast disease or prophylaxis. However, the goals for transmen differ, as they include aesthetic contouring of the chest wall by removal of breast tissue and excess skin; reduction and proper positioning of the nipple and areola; obliteration of the inframammary fold; and minimization of chest wall scars (Hage and Kesteren 1995)—in short, the creation of an aesthetically pleasing male chest. Many of the techniques for the treatment of gynecomastia have been used or modified in SCM for transmen, and the methods and indications for each have been discussed in the literature (Eicher 1992; Hage & Kesteren 1995; Lindsay 1979). The reports describe liposuction, semicircular circumareolar techniques, concentric circular techniques, transareolar incisional techniques, and more radical procedures such as breast amputation with a free nipple graft (Davidson 1979; Dolsky 1990; Letterman & Schurter 1972; Pitanguy 1966; Webster 1946).

Poor aesthetic outcomes following in transsexual patients include contour abnormalities (breast, inframammary fold, and nipple); issues relating to the nipple–areola complex (NAC) (size, placement, and viability); skin redundancy; and poor scarring (Hage and Kesteren 1995; Simon & Hoffman 1976). Secondary corrections often are the rule rather than the exception.

Indeed, performing SCM in transmen is more difficult than in a male with gynecomastia since, in most cases, transmen will usually have more breast volume and a greater degree of skin excess and ptosis. According to Hage and Kesteren (1995), skin excess, not breast volume, is the factor that should determine the appropriate SCM technique. Based on more than 400 SCMs we have performed for transmen over the past 15 years, we agree that skin quality—specifically, skin "elasticity"—also is a key factor. It can make the difference between a good aesthetic outcome and a poor one, especially with a less experienced

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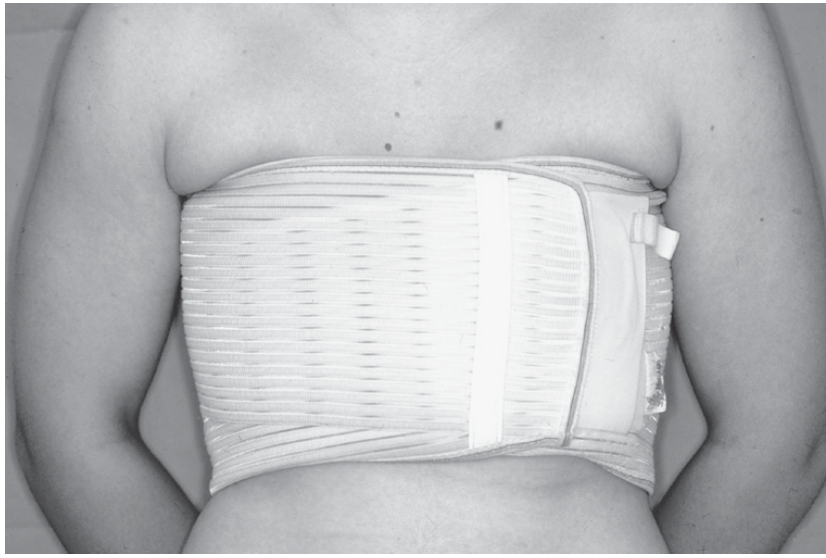

Figure 15.1 Breast binding to camouflage a feminine-looking chest.

surgeon. It is important to be aware that, in this patient population, poor skin quality can be exacerbated when the patient has engaged in years of "breast binding" (Figures 15.1 and 15.2).

Surgical Techniques

The difficulty with SCM lies less in the procedure itself (although it is wrongly considered an "easy" procedure), and more in the choice of technique. Therefore we have developed an algorithm which helps us to choose from five techniques, resulting in an aesthetically pleasing male chest (Monstrey et al. 2008). Preoperative parameters to be evaluated include breast volume; degree of excess skin; NAC size and position; and skin elasticity.

If the patient is a smoker, the surgeon should discuss the effects of the habit on the skin quality, wound healing, and vascularity, and encourage the patient to stop smoking. This is especially important if a free-flap phalloplasty is to be performed later. Hormonal therapy is stopped 2–3 weeks preoperatively.

Early in our series, we carried out each patient's complete sex reassignment surgery in a single stage. SCM, hysterectomy, and oophorectomy, vaginectomy with scrotoplasty, and phalloplasty, including reconstruction of the fixed part of the urethra, were all performed in one operation. Many of these procedures were carried out simultaneously by different surgical teams. However, the combination proved too lengthy, especially for a patient with larger breasts. Until 1 year ago we combined the SCM procedure with a laparoscopic hysterectomy

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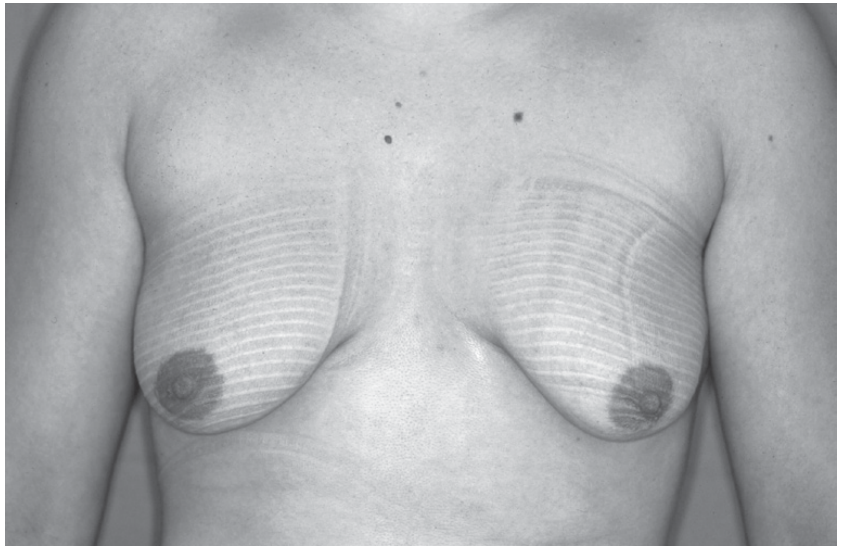

Figure 15.2 Breast binding can result in a ptotic breast with poor skin elasticity.

and oophorectomy in the first stage. Vaginectomy, scrotoplasty, and phalloplasty with reconstruction of the fixed part of the urethra were later carried out in a second stage. More recently, we consider performing the SCM first, then the hysterectomy with BSO and reconstruction of the fixed part of the urethra with vaginectomy and scrotoplasty (in fact, a metoidioplasty operation), and only 6 months later a phalloplasty.

Regardless of the technique, it is extremely important to preserve all subcutaneous fat when dissecting the glandular tissue from the flaps. This ensures thick flaps that produce a pleasing contour and do not subsequently become tethered to the chest wall. For the same reason, we preserve the pectoralis fascia. We do not perform liposuction at the anterior aspect of the breast. However, a judicious use of liposuction can occasionally be indicated laterally, or to attain complete symmetry at the end of the procedure. The inframammary fold is always released, an especially important maneuver for patients with large breasts. This is done by extending the inferior flap on to the abdomen and, where a tight band exists, incising it with multiple transverse cuts. Postoperatively, a circumferential elastic bandage is placed around the chest wall and maintained for a total of 4–6 weeks.

The *semicircular technique* (Figure 15.3) is essentially the same procedure as that described by Webster in 1946 for the correction of gynecomastia. It is useful for individuals with smaller breasts. The resulting scar will be confined to the lower half of the periphery of the areola (infra-areolar). A sufficient amount of glandular tissue should be left in situ beneath the NAC in

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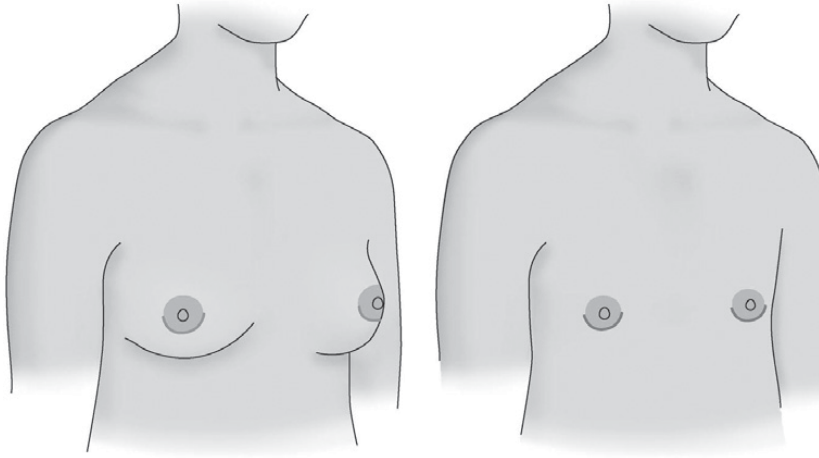

Figure 15.3 Semicircular technique: incisions and scars.

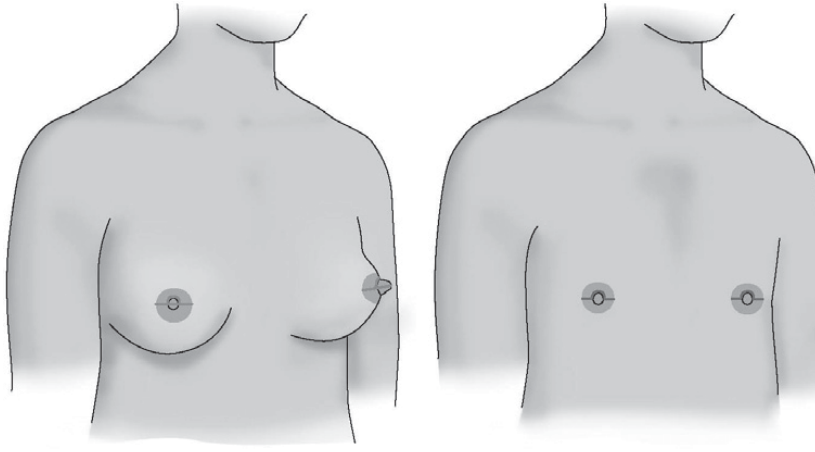

Figure 15.4 Transareolar technique: incisions and scars.

order to avoid a depression. The advantage of this technique is the small and well-concealed scar, which is confined to the NAC. The major drawback is the small window through which to work, making excision of breast tissue and hemostasis more challenging. Care must be taken to avoid overzealous traction on the skin edges with retractors, which could result in wound dehiscence or marginal skin necrosis.

In cases of smaller breasts with large prominent nipples, the *transareolar technique* (Figure 15.4) is used. This is similar to the procedure described by

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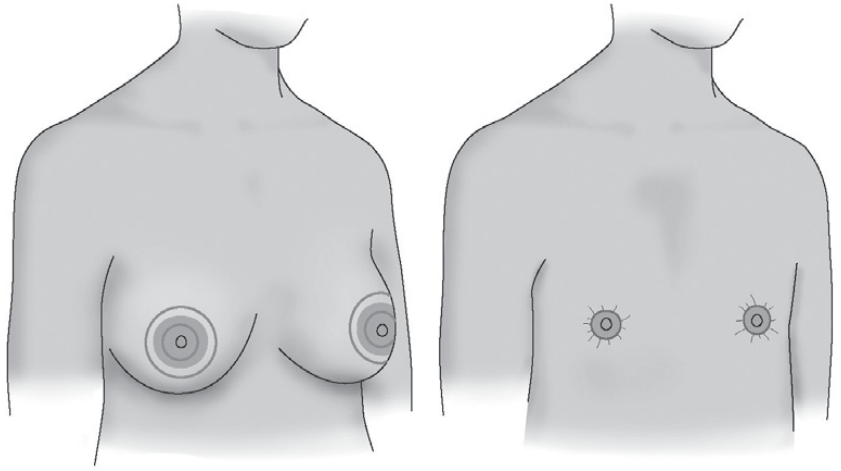

Figure 15.5 Concentric circular technique: incisions and scars.

Pitanguy in 1966. It allows for a subtotal resection of the nipple and usually incorporates the upper aspect, which tends to ameliorate the downward effect of gravity. The resulting scar traverses the areola horizontally and passes around the upper aspect of the nipple. The additional advantage of this technique is that it allows an immediate nipple reduction. The disadvantage is the same as with the semicircular technique, i.e., it is more difficult to excise breast tissue and achieve hemostasis. Additionally, the transareolar scar is usually somewhat more apparent.

The *concentric circular technique* was described by Davidson in 1979 (Figures 15.5, 15.6, and 15.7). It is used for breasts with a medium-sized skin envelope (B cup), or smaller breasts with poor skin elasticity. The resulting scar will be confined to the circumference of the areola. The concentric incision can be drawn as a circle or ellipse, enabling deepithelialization of a calculated amount of skin in the vertical or horizontal direction (Hage & Kesteren 1995). Access is gained via an incision in the inferior aspect of the outer circle. Glandular tissue is carefully dissected off the overlying NAC, leaving it widely based on a dermal pedicle. In this case, it is not necessary to leave excess glandular tissue beneath the NAC, as the folded deepithelialized dermis surrounding the areola provides sufficient NAC projection and prevents nipple–chest wall tethering. A permanent purse-string suture is placed and set to the desired areolar diameter (usually ±20 mm). The advantage of this technique is that it allows for reduction and/or repositioning of the areola, where required, and for the removal of excess skin. It also affords good exposure for glandular excision and hemostasis. It does, however, require experience in determining the amount of skin to be deepithelialized.

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Figure 15.6 Concentric circular technique: preoperative view.

The *extended concentric circular technique* (Figure 15.8) is similar to the concentric circular technique, but includes one or two additional triangular excisions of skin and subcutaneous tissue, which may be inferior and lateral, or medial and lateral. Access for excision of the glandular tissue is provided through these additional skin excisions. This technique is useful for correcting skin excess and wrinkling produced by large differences between the inner and outer circles. On the few occasions where a single vertical triangular excision inferior to the NAC was utilized, the results were suboptimal. Subsequently, this technique was abandoned. Here too, a permanent purse-string suture is placed and set to the desired areolar diameter. The resulting scars will be around the areola, with horizontal extensions on to the breast skin, depending on the degree of excess skin. The advantages of this technique are the wide exposure for glandular excision and hemostasis, NAC reduction and repositioning, and tailoring of excess skin resulting in fewer wrinkles around the areola. The major drawbacks are that the residual scarring is no longer confined to the NAC, and experience is required in planning the amount of tissue to be excised and/or deepithelialized.

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Figure 15.7 Concentric circular technique: postoperative view.

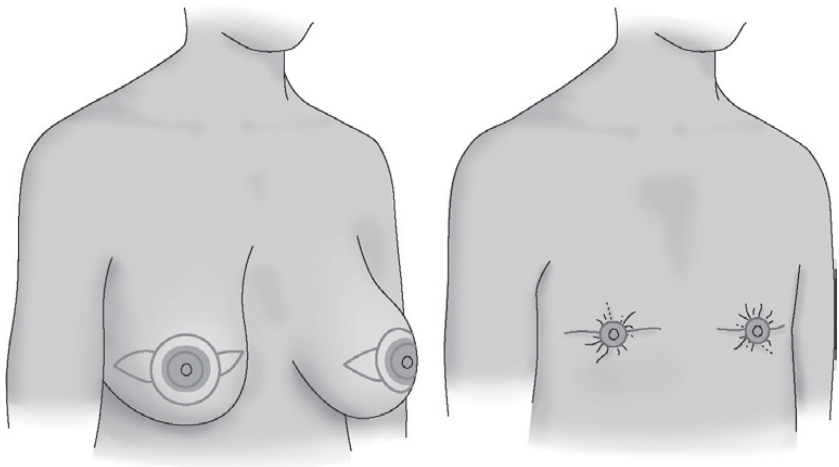

Figure 15.8 Extended concentric circular technique: incisions and scars.

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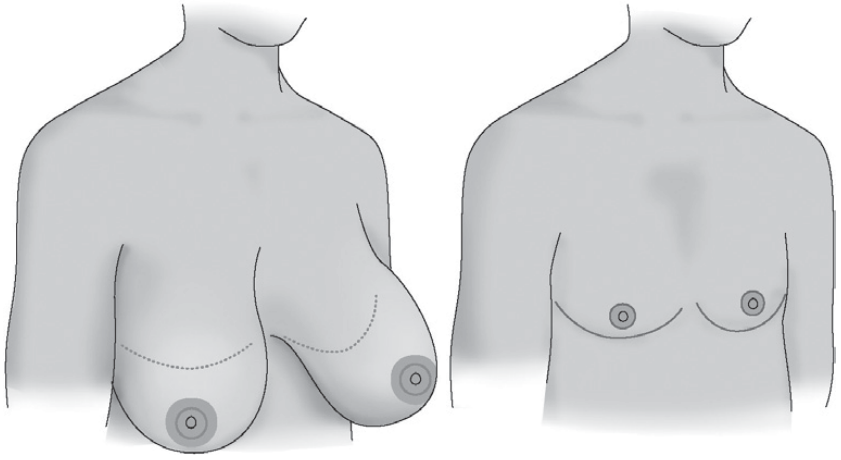

Figure 15.9 Free nipple graft technique: Incisions and scars.

Figure 15.10 Free nipple graft technique: preoperative view.

The *free nipple graft technique* has been proposed by several authors for patients with large and ptotic breasts (Eicher 1992; Hoopes 1974; Kenney & Edgerton 1989; Kluzak 1968; Lindsay 1979) (Figures 15.9, 15.10, and 15.11).

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Figure 15.11 Free nipple graft technique: postoperative view.

It consists of harvesting the NAC as a full-thickness skin graft; amputating the breast; and grafting the NAC on to its new location on the chest wall. Our preference is to place the incision horizontally 1–2 cm above the inframammary fold, and then move upward laterally below the lateral border of the pectoralis major muscle. The incisions should not cross the midline. Following breast amputation, the superior flap is pulled downward to eliminate skin redundancy. At this stage, judicious defatting or liposuction may be performed laterally and medially to avoid "dog-ear" formation and ensure symmetric contouring. Again, care should be taken to leave the fat on the undersurface of the breast flaps. Following closure, the NAC is grafted on to the desired position on the chest wall.

Regarding ideal placement of the NAC, we feel that the use of absolute measurements can be misleading. We agree with the recommendations of many authors who position the NAC according to the patient's own anatomical landmarks (Beckenstein et al. 1996; Beer et al. 2001). In our series, the nipples were placed along the existing nipple line and the height was adjusted to approximately 2 cm above the lower border of pectoralis major. In a typical patient, this will correspond to the fourth or fifth intercostal space. Clinical judgment is most important, however, and we always sit the patient up intraoperatively to check final nipple position.

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The diameter of the NAC is 20–25 mm and is cut while the area is stretched circumferentially. The resulting scars will include a line on the inferior aspect of the new male breast, in addition to one around the areola. The advantages of the free nipple graft technique are excellent exposure and more rapid resection of tissue, as well as nipple reduction, areola resizing, and repositioning. The disadvantages are the long residual scars, NAC pigmentary, and sensory changes, and the possibility of incomplete graft take.

Complications

The overall postoperative complication rate in our series—around 10%—is similar to that in most other series described in the literature. A hematoma was the most frequent complication. As one might expect, the frequency of hematoma decreases as one moves from the first periareolar technique to the extended concentric and free nipple graft technique in which wider access is provided. Some of the other complications were associated with hematoma: (partial) nipple necrosis and abscess formation. Drains and compression bandages did not necessarily prevent the occurrence of this troublesome complication. This underscores the importance of achieving good hemostasis intraoperatively. Smaller hematomas and seromas can be evacuated through puncture. However, in about half of the cases, surgical evacuation was required.

A significant complication includes simple skin slough of the NAC, which can be left to heal by conservative means. The exceptional cases of partial or total nipple necrosis may require a secondary nipple reconstruction.

Unlike Hage, we rarely planned a two-stage procedure. Nevertheless, despite a rather low complication rate, about one-third of patients required an additional procedure to improve the aesthetic results. The likelihood of an additional aesthetic correction should be discussed with the patient in advance (Beer et al. 2001).

Sometimes, the secondary procedure is performed as part of a planned two-stage event. In the first stage, the skin initially is left oversized to enable it to shrink fully without stretching the scars and areola. This may somewhat reduce the length of the ultimate scar (depending upon the elasticity of the skin). Obviously, the secondary procedure is always necessary.

Recommendations

For a breast with a small envelope and good skin elasticity, a semicircular technique is suitable. The same breast with an oversized nipple is well suited to a transareolar technique. The same breast with moderate to poor elasticity, or a breast having a larger envelope (cup B, grade 1 or 2 ptosis), will require a concentric circular technique. A moderate-sized breast (cup B–C, grade 1 or 2 ptosis) with poor skin elasticity will require an extended concentric circular technique. Finally, a large-volume breast (cup C or larger) with substantial skin excess and little or no skin elasticity will likely require a breast amputation with

free nipple grafting. Inevitably, this involves more incisions and longer scars. However, when having to choose between scar and contour, we have noticed that the majority of our patients prefer a better contour above a shorter scar: for this reason we have performed many more free nipple graft technique SCMs in recent years.

It is important to note that there have been reports of breast cancer after bilateral SCM in this population (Burcombe et al. 2003; Secreto et al. 1984; Symmers 1968). Preservation of the NAC after SCM leaves behind insensate ductal tissue at risk for malignant transformation. Residual breast tissue persists even after the most radical prophylactic mastectomy, and a regular SCM never removes all glandular tissue. Although the precise causative role of androgens in breast cancer etiology is unclear, the association between high androgen levels and breast cancer risk is well documented. Apparently, high-circulating androgen in postmenopausal women may increase estrogens via peripheral aromatization of dihydroepiandrostenedione to estradiol and estrone in breast and adipose tissue. This prolonged and unopposed estrogenic stimulation could increase breast cancer. Additionally, family history of breast cancer may play a role in this scenario. Lifelong follow-up of these patients is, therefore, required.

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Hysterectomy and Salpingo-Oophorectomy

Transpeople who are searching for information concerning their decisions to have reproductive organ surgery will only find anecdotal material on the internet and a limited amount of information, much of it conflicting, in the medical literature. They will not find any large study of transmen that addresses the subjective experience of hysterectomy, issues of postoperative hormone treatment, sexual satisfaction, or the potential for regret.

Kaiser et al. (2011) conclude that the vaginal hysterectomy with bilateral vaginal adnexectomy after performing a total colpectomy is the optimal choice for reassignment surgery. Other researchers state that a total laparoscopic hysterectomy also offers appropriate surgical outcomes and even is the method of choice for hysterectomy in transmen (O'Hanlan et al. 2007; Weyers et al. 2008). Laparotomy results in a stigmatizing (Pfannenstiel) incision and should be avoided. Laparotomy should only be performed on special indications due to relevant intra-abdominal morbidity or to solve surgical complications (Van Trotsenburg 2009). In a Dutch study conversion from laparoscopy to laparotomy was necessary in one patient (1/32; 3.1%), which was considered an adverse event. None of the patients required reoperation or readmission to hospital (Ott et al. 2010).

There is unanimity in the literature that adequate counseling on the topic of fertility preservation within a multidisciplinary team is very important. The irreversible nature of the surgery as well as its impact on reproduction should be emphasized. Transmen can consider oocyte or embryo cryopreservation (De Sutter 2009). However, more research is needed to enhance fertility options for transmen (Wierckx et al. 2012).

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Phalloplasty

Introduction

The goals of a phalloplasty include reconstructing an aesthetically pleasing penis, with erogenous and tactile sensation, which enables the patient to void while standing and have sexual intercourse like a man, in a one-stage procedure (Gilbert et al. 1987; Hage et al. 1993). The reconstructive procedure should also provide a normal scrotum and be predictably reproducible without functional loss in the donor area, and leave the patient with minimal scarring or disfigurement.

Since the first penile reconstruction performed in 1936 by Bogoras with a tubed abdominal flap, the development of phalloplasty has paralleled the overall evolution and advances in plastic and reconstructive surgery. Historically, phallic reconstruction required complex multistage procedures using tubed skin flaps or pedicled myocutaneous flaps (Hoopes 1974; Horton 1973; Orticochea 1972). More recently, microsurgical techniques have allowed for the selection of distant flaps with the transfer of free vascularized tissue and the coaptation of nerves from the donor flap to recipient nerves in the perineum (Biemer 1988b; Chang & Hwang 1984; Hage & De Graaf 1993; Harashima et al. 1990; Gilbert et al. 1987; Koshima et al. 1986; Meyer & Daverio 1987; Sadove et al. 1993; Santanelli & Scuderi 2000; Upton et al. 1987). Despite the multitude of free flaps that have been employed and described (often as case reports), the radial forearm is universally considered the "gold standard" in penile reconstruction (Chang & Hwang 1984; Fang et al. 1999; Gilbert et al. 1987; Hage et al. 1993; Monstrey et al. 2009).

This chapter will describe to what degree the radial forearm flap has been able to meet the criteria for ideal penile reconstruction as well as provide an overview of the different other phalloplasty techniques.

Requirements for an Ideal Penile Reconstruction

According to Hage et al. (1993), to achieve the ideal phalloplasty one should aim for: (1) a one-stage procedure that can be predictably reproduced; (2) creation of a competent neourethra to allow for voiding while standing; (3) return of both tactile and erogenous sensibility; (4) enough bulk to tolerate the insertion of a prosthetic stiffener facilitating sexual intercourse; (5) an aesthetically pleasing phallus; (6) minimal morbidity; and (7) no functional loss and minimal scarring in the donor area.

A "One-Stage" Procedure

In our opinion genital reassignment surgery in transmen, which attempts to even partially meet the desired outcome, can never be achieved in a "one-stage" procedure. Genital surgery is usually performed 1 year after the patient underwent SCM and hysterectomy and BSO. For logistic reasons

and to further reduce the complication rate, we nowadays even consider performing an SCM alone in a first operation, then a metoidioplasty (including vaginectomy and scrotoplasty) and only 6 months later a phalloplasty. Combining these procedures in an "all-in-one" procedure is inadvisable as it would result in lengthy operations (more than 10 hours) with considerable blood loss. In addition, early SCM greatly facilitates the real-life experience, which is required for genital reassignment surgery and is important to the patient. For implantation of testicular and/or erection prostheses, an additional operative procedure is required, usually 1 year after the phalloplasty. This delay is necessary to allow nerves to regenerate, as a return of sensation to the top of the phallus is essential to prevent implant complications.

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Voiding While Standing

In 2009 a retrospective review of 287 radial forearm phalloplasties was performed at our center, showing that all patients were ultimately able to void while standing (Monstrey et al. 2009). Since that report about 300 more phalloplasties have been performed by the same team of surgeons with similar good (or even slightly better) results. This is in contrast to the results for patients who underwent other phalloplasty techniques (Baumeister et al. 2011; Felici & Felici 2006; Sengezer et al. 2004). For transmen seeking phalloplasty, the ability to void while standing is generally a high priority. However, many surgeons prefer no longer to reconstruct a neourethra because of the high incidence of urological complications.

In our first series urologic complications were seen in 41% of patients (119 of 287), with a fistula in 72, a stricture in 21, and a combination of both in 26. The majority of the fistulas (51 of 72) closed spontaneously, and many strictures (especially at the meatus) could be managed with dilatation. Although this complication rate may seem high, it is low in comparison to other reports (Biemer 1988; Davies & Matti 1988; Fang et al. 1999; Gilbert et al. 1987). In those cases where the fistula did not close spontaneously, a secondary procedure was required. It consisted of a simple closure of the fistula, and/or an open approach with longitudinal incisions closed transversely or, in the case of longer and recurrent strictures, local skin flaps. Since 2009 we have not performed a more recent review of our (about 300 additional) radial forearm phalloplasties, but we have the subjective feeling that the complication rate has been stable.

We have demonstrated that the long-term effects on urinary tract function are minimal after phalloplasty combined with reconstruction of the fixed part of the urethra (Hoebeke et al. 2003). However, it is unknown how the new urethra—a 16-cm skin tube—affects bladder function over the long term. Therefore, from a urological point of view, lifelong follow-up is always required. This underscores the importance of a close collaboration between the reconstructive surgeon and the urologist.

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Tactile and Erogenous Sensation

The extent of the recovery of tactile and erogenous sensation in the reconstructed penis is crucial. Of the various donor flaps used for penile reconstruction, the forearm flap has the greatest sensitivity (Gilbert et al. 1987). The medial and lateral antebrachial nerves are easily identified at the beginning of the flap elevation, and dissected an additional 5 cm proximal to the skin paddle to facilitate the anastomosis to the nerves in the groin area. In all patients in our series, one forearm nerve was connected to the ilio-inguinal nerve for protective sensation, while the other antebrachial nerve was connected with one of the two dorsal clitoral nerves. The other clitoral dorsal nerve was left unharmed. The denuded clitoris was always left directly below the phallic shaft. Consequently, manipulation of the neophallus can further stimulate the still-innervated clitoris. This explains why several patients were able to masturbate a few months (or even weeks) after phalloplasty.

In a long-term follow-up study of our patients' sexual and physical health after sex reassignment surgery, more than 80% reported improvement in sexuality. Transmen reported masturbating significantly more often than transwomen and experiencing greater sexual satisfaction, more sexual excitement, and greater ease in reaching orgasm (De Cuypere et al. 2005).

Sexual Intercourse

When using skin flaps for penile reconstruction, a rigidity prosthesis is required in order to engage in sexual intercourse postoperatively. After phalloplasty and scrotoplasty the phallus is flaccid and the scrotum is empty (Hoebeke et al. 2010; Selvaggi et al. 2009). In order to make the new constructed genital look and function as natural as possible, scrotal and penile implants are needed (Hoebeke et al. 2003). Most often these implant procedures are the last stage of reconstruction, preferably 1 year after phalloplasty. At that time most urethral complications will be resolved, sensitivity will be installed, and vascular integration of the phallus will be maximal, decreasing the risk of vascular complications during implantation.

Obtaining rigidity after phalloplasty remains however a real challenge and many complications are reported (Hage et al. 1993; Hoebeke et al. 2010; Leriche et al. 2008).

Different possibilities are available to obtain rigidity. When the phallus is constructed by use of a fibular flap or a radial forearm flap, theoretically part of the fibula or the radius could be transplanted with the flap, thus allowing for rigidity. Unfortunately, the limited amount of bone that can be taken from the distal radius or fibula can never function as a real rigidity device, and the risk of donor site complications is greatly increased (Biemer 1988b; Cavadas 2008; Koshima et al. 1986). In addition, bone or cartilage grafts may absorb or render a pointed deformity to the distal part of the penis, where the extra skin can

glide around the end of the bone. Moreover, a permanently erected phallus can be an embarrassment that cannot be easily concealed.

Some centers use two myocutaneous gracilis flaps for penile reconstruction in order to achieve some erectile function when contracting both muscles (S. Suominen personal communication).

Commercially available erectile implants have the advantage of being readily available in many formats, lengths, and sizes and their use in biological males has been very successful for survival and for quality of life of the patients after implantation.

One of the major complications while implanting an erectile device is infection. With antibiotic-impregnated prostheses the infection rate in large groups of biological males has been reduced to around 1% (Carson et al. 2011). However there is an important difference when comparing the implantation in biological males to implantation in a neophallus. In biological males the prosthesis is implanted in the corporal bodies which serve as extra protection against protrusion and in which some blood flow is preserved, enhancing the effect of the local antibiotics. In neophallus the prosthesis is implanted in fatty tissue with low blood supply and without corporal bodies to protect. Many authors describe ways to overcome the lack of corporal bodies by inserting the devices in either Gore-Tex (W.L. Gore and Associates, Newark, DE) or Dacron (DuPont, Wilmington, DE) covers. Furthermore these covers are used to anchor the prosthesis to the pubic bone (Garaffa et al. 2011).

Other options for rigidity are the use of external devices like silicone condoms which can be used over the phallus; however, no studies have been published on the use of these devices.

In our center we have a large experience with erectile devices. The strategies have changed with time based on experience.

In general we experienced that inflatable devices have a limited survival time. There are many reasons why they tend to fail more than the series that have been published in biological males. Biological males receive their implant to treat erectile dysfunction so in general they are older, have in general lower libido, and thus lower frequency of using their implants. Transmen are younger, receive testosterone, and in general have high libido, so they tend to use the prosthesis more often and of course much longer as they are younger. Next to the frequency of use there is also the unlimited space for expansion of the prosthesis as they are not contained in the corporal bodies.

Initially a one-piece hydraulic prosthesis (Dynaflex, AMS Minnetonka, Minnesota) fully covered with Dacron was used, usually in combination with two testicular prostheses. In that series we could see a high amount of leakage due to the rubbing of the silicone against the Dacron, causing wearing of the silicone sheath of the cylinder and leak (Hoebeke et al. 2003). When this implant became unavailable, we switched to the three-piece AMS CX prosthesis. In this device, the pump replaced one testicular prosthesis. Good results were initially reported with this three-piece prosthesis; however we encountered an increase in technical failure due to leakage, probably because there

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was no limit to the amount of fluid that can be pumped into the cylinders. In a three-piece system there is a reservoir containing 65 mL of saline. We therefore shifted to the two-piece device (Ambicor, AMS), a system that limits the amount of fluid available as the reservoir is integrated in the pump and thus contains less saline. With this two-piece system the initial results were good but after longer follow-up the problem of leakage and malposition was observed, as well as a problem of lack of rigidity. In a first long-term follow-up study, re-intervention in about one in four patients was observed. However, more than 80% of patients were able to have normal sexual intercourse with penetration (Hoebeke et al. 2003).

In an observational study on quality of sexual life it was observed that patients with erection prostheses were more able to attain their sexual expectations than those without prostheses, although the group with prostheses more often reported pain during intercourse (De Cuypere et al. 2005).

In 2010 we reported a longer follow-up on erectile implants. A total of 129 transmen implanted between March 1996 and October 2007 were evaluated. The mean follow-up was 30.2 months (range: 0–132 months). Dynaflex prosthesis was implanted initially in 9 patients, a three-piece hydraulic device (AMS CX or AMS CXM) in 50 patients, and a CX Inhibizone, Ambicor, and Coloplast/Mentor prosthesis in 17, 47, and 6 patients, respectively. Of 129 patients, 76 patients (58.9%) still had their original implant in place. Fifty-three patients (41.1%) needed to undergo either removal or revision of the prosthesis due to infection, erosion, dysfunction, or leak. Forty-one patients underwent a replacement of the prosthesis, 9 needed a second revision, 5 needed a third revision, and 1 patient needed a fourth revision of prosthesis. Malposition of prosthesis was corrected by surgical repositioning so that removal or revision could be avoided. Of 185 prostheses used in 129 patients, 108 (58.4%) still remain in place, with a total infection rate of 11.9%, a total protrusion rate of 8.1%, a total prosthesis leak rate of 9.2%, a total dysfunction rate of 13%, and a total malposition rate of 14.6% (Hoebeke et al. 2010).

With the last observation of higher complication rates with longer follow-up we started to propose the use of semi-rigid implants in transmen. We use a Spectra semi-rigid prosthesis (AMS Minitonka USA) in a Gore-Tex sleeve. This is a titanium-based prosthesis which has the advantage that it is concealed when bent downwards. The results of this prosthesis have not yet been evaluated but malfunction due to leakage is impossible with this device. We observed some infection problems and some malposition but in general it is our impression that the semi-rigid device is more durable.

An Aesthetically Pleasing Phallus and Scrotum

A plethora of techniques for penile reconstruction implies that none is yet considered to be ideal. Most surgeons agree that only microsurgical free-flap techniques lead to optimal functional and aesthetic results in phallic reconstruction (Chang & Hwang 1984; Fang et al. 1994; Gilbert et al. 1987;

Figure 15.12 Late result after tattooing of the glans to imitate a circumcised penis.

Gottlieb & Levine 1993; Hage et al. 1993; Koshima et al. 1986; Sadove et al. 1993; Young et al. 1992).

The radial forearm flap, modified by Chang and Hwang (1984), has been widely accepted as the best donor site for penile reconstruction. It was used in up to 85% of the published phalloplasty cases.

The flap is thin and pliable, thus allowing the reconstruction of a tube (the urethra) within a tube (the penis). The flap is easy to dissect, is predictably well vascularized and, most uniquely, has easily identifiable sensory nerves. The ulnar aspect of the flap is often hairless and can, therefore, be used as a lining for the urethra. There have been many reports of other free flaps for phallic reconstruction: the lateral arm flap (Shenaq & Dinh 1989; Young et al. 1992), the deltoid flap (Harashima et al. 1990), the dorsal foot flap (Cheng et al. 1995), the parascapular flap (Liang personal communication), the anterolateral thigh (ALT) flap (Felici & Felici 2006), the fibular osteocutaneous flap (Sadove et al. 1993), and the tensor fasciae latae myocutaneous flap (Santanelli & Scuderi 2000), but none have gained wide acceptance.

To achieve an aesthetic phallic reconstruction, it is essential to perform a procedure that can be replicated with minimal complications. Features which increase the aesthetic aspect of the reconstructed penis are preoperative epilation of the forearm, reconstruction of a corona, and a glans of the penis, and tattooing of the glans (Figure 15.12).

The cosmetic outcome of a phalloplasty procedure with a radial forearm flap is a subjective determination, but the ability of most transmen to shower with

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other men or to go to the sauna naked is the usual cosmetic barometer. Another major aesthetic concern is the aspect of the grafted donor site on the forearm. These results might be related to a suprafascial dissection of the flap sparing the paratenon as well as advancing the skin edges after harvesting of the flap and putting extra attention towards obtaining a flat contour of the underlying muscle surface with careful graft placement to avoid additional wrinkling and scarring.

Drawbacks of the radial forearm flap are the need for rigidity prosthesis and the potential for the flap to become softer and shrink over time, resulting in loss of more than 20% in circumference. This seems to be related to an unexplained degree of atrophy of subcutaneous fat.

The goal of creating natural-appearing genitals also applies to the scrotum. As the labia majora are the embryological counterpart of the scrotum, many scrotoplasty techniques have used this hair-bearing skin. Previous approaches left the labia in situ, with midline closure and prosthetic implant filling, or brought the scrotum in front of the legs using a V-Y plasty. These techniques were aesthetically unappealing and reminiscent of the female genitalia.

Full-thickness skin grafts taken from the groin area have been used to cover the donor defect on the forearm, making the donor site somewhat better aesthetically, but the resulting additional tension after excision of these grafts made the reconstruction of a scrotum much more difficult. Several patients required a secondary expansion of the former labia majora before testicular prostheses could be implanted.

We employ a scrotoplasty technique, which combines a V-Y plasty with a 90° turning of the labial flaps. In this procedure, additional labial skin is transposed forward to enlarge an anteriorly located scrotum. Compared to the outcomes of the earlier procedures, the aesthetic results of this scrotoplasty are excellent (Figures 15.13 and 15.14). Erogenous sensation is increased by scrotoplasty and the recent refinement of preserving the clitoral hood. The functional advantage of fewer urological complications and easier implantation of testicular prostheses make this the technique of choice.

Testicular implants after phalloplasty do not differ from those used in biological males. Most often silicone gel-filled implants are used and they are available off the shelf in different sizes—small, medium, and large. The size used depends on the available space. If an inflatable erectile device is chosen there needs to be extra space for the pump of the erectile device. The pump often is large enough to fill one scrotal part, so most patients who choose an inflatable erectile device will need only one testicular prosthesis. With semi-rigid erectile devices two testicular prostheses will be implanted, one along the incision used for the erectile implant and one via a contralateral inguinal incision. An inguinal incision to place the testicular prosthesis is indeed preferred as the scrotum has often many scars related to the reconstruction, and reopening a scarred area increases the risk of wound infection and delayed or poor wound healing in general. Indeed, the risks of implantation of testicular prosthesis are infection and perforation. The space for the prosthesis is developed bluntly,

Figure 15.13 Scrotal reconstruction with transposition flaps of the labia before insertion of prostheses.

Figure 15.14 Scrotal reconstruction with transposition flaps of the labia after insertion of prostheses.

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starting at the inguinal incision. Testicular implants can dislocate from their original position, especially if too large a size is chosen for the area. Capsule formation and retraction are rare but can happen.

There is only little published information on testicular implants in transmen. Some plastic surgeons tend to use tissue expanders in the labia majora in order to create space for implants (Sengezer & Sadove 1993). In the technique of scrotoplasty described by Selvaggi et al. (2009), the scrotal reconstruction aims at bringing the scrotum in front of the legs. When the labia are preserved in their anatomical position and just closed in the midline, then the patient will have problems with the testicular implants while sitting and the chance of dislocation of the implants will increase.

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Minimal Morbidity

As in all cases of gender reassignment surgery, hormonal therapy was stopped 2–3 weeks prior to phalloplasty.

Complications following phalloplasty included the general complications attendant to any surgical intervention, such as bleeding, infection, and delayed wound healing. Vaginectomy, which is a particularly difficult operation, carries a potentially high risk of postoperative bleeding. In our series, revision for bleeding in the vaginal cavity was required in 3 patients. Fortunately, none of the patients in this series suffered a rectal perforation during the rather delicate vaginectomy procedure.

About 15% of patients needed additional dressings for minor wound-healing problems in the groin area. These problems were all resolved with conservative measures. Two early patients displayed symptoms of nerve compression in the lower leg, due to prolonged restraint in a gynecological lithotomy position. Subsequently, we limited the length of the restraint to under 2 hours, and this complication no longer occurred.

Apart from the urinary fistulas and stenoses which have been previously described, most complications of the radial forearm phalloplasty stem from the fact that the free vascularized tissue transfer necessitates a microsurgical connection of small blood vessels. Jacques Baudet (1997), an authority in this field, claimed that microvascular flap transfer in penile reconstruction involved more complications than did other free-flap transfers.

In our experience, surgical reintervention due to early vascular compromise of the flap was required in a rather high percentage of cases (12%). In one-third of patients, there was an arterial thrombosis; in two-thirds, a combination of both arterial and venous thrombosis. Treatment consisted of thrombectomy and the reconstruction of an arterial-venous fistula at the end of the penis by anastomosing the distal end of the radial artery to the cephalic vein to improve venous outflow. Still, the total flap failure in this series of radial forearm flap phalloplasties was surprisingly low, less than 1% ($n = 2/287$).

In contrast, about 7.5% of patients demonstrated a minor degree of skin slough or partial necrosis. This was often the case for those who insisted on a

large-sized penis, which requires a larger flap, involving almost the entire circumference of the lower arm.

As in all cases of (free) flap failure, smoking was a significant risk factor. Under our present policy, patients who fail to quit smoking 1 year prior to surgery do not qualify for phalloplasty.

None of our patients demonstrated complications due to general anesthesia. Despite the fact that all patients received fractioned heparin subcutaneously, and elastic stockings were routinely used, 2 patients developed a (minor) pulmonary embolism.

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No Functional Loss and Minimal Scarring in the Donor Area

Although the radial forearm flap is indeed the gold standard, the major drawback has always been the highly visible and unattractive donor site scar on the forearm (Figure 15.15). As seen in the treatment of burns, full-thickness skin grafts leave a more attractive scar, compared to split-thickness skin grafts. For this reason a full-thickness skin graft taken from the groin area was used in the first 50 patients in our series. However, due to consequential tension in the groin area, the reconstruction of the scrotum became more difficult. Therefore, we switched to split-thickness skin grafts taken from the anterior and medial thigh. Indeed, the average transman would prefer an aesthetically pleasing scrotum over a slightly less unattractive forearm donor site. For 6–12 months following radial forearm phalloplasty, the patient must wear a pressure garment and/or silicone on the forearm, as would a patient with a severe extremity burn.

We conducted a long-term follow-up study (Selvaggi et al. 2006) to assess the degree of functional loss and aesthetic impairment after harvesting a large radial forearm flap. (While small and moderately sized flaps are often used for head and neck reconstruction, in penile construction, the flap involves the complete circumference of the forearm, including all superficial nerves and veins.) Surprisingly, the rate of complications, ranging from hematoma to incomplete graft, was extremely low. We had expected increased morbidity, but we found that neither early nor late complications differed from the rates reported in the literature for smaller flaps. No major or long-term problems (such as functional limitation, chronic pain, cold intolerance, or evidence of vascular compromise) were identified.

With regard to the aesthetic outcome of the donor site, we found that the patients were very accepting of the donor site scar, viewing it as a worthwhile trade-off for the creation of a phallus.

The Radial Forearm Flap

At the University Hospital of Ghent, Belgium, the same team of surgeons has performed phallic reconstruction using a radial forearm flap on more than 600 consecutive transmen. The following section will describe our current

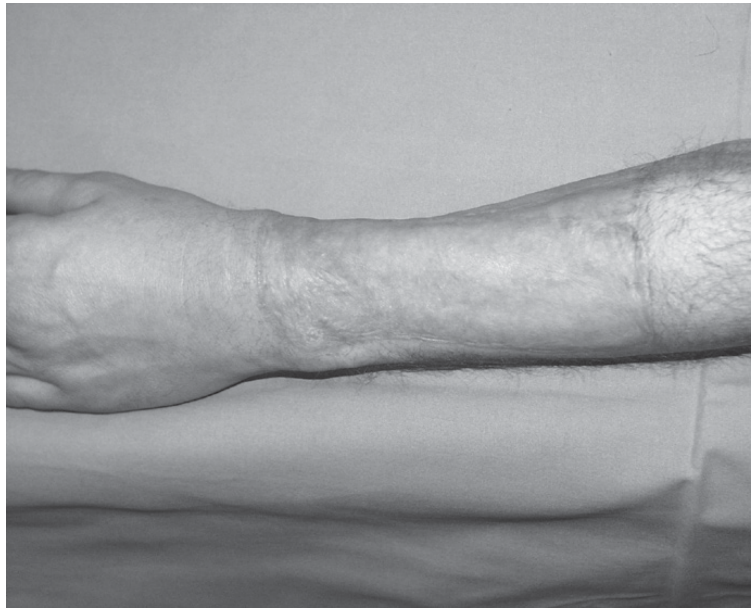

Figure 15.15 Aspect of the donor site on the arm after a phalloplasty procedure.

technique and the refinements we have introduced to improve the results, both functionally and cosmetically.

Two surgical teams operate at the same time, and the patient is first placed in a gynecological position. In the perineal area, the urologist performs a vaginectomy, and lengthens the urethra with mucosa between the minor labiae. The vaginectomy is a mucosal culpectomy in which the mucosal lining of the vaginal cavity is removed. After excision, a pelvic floor reconstruction is always performed to prevent possible later conditions such as cystocele or rectocele. The levator ani muscle is reconstructed, as in a colporrhaphy. This reconstruction of the fixed part of the urethra is combined with a scrotal reconstruction by means of two transposition flaps of the greater labia, resulting in a very natural-looking bifid scrotum (Selvaggi et al. 2009).

Simultaneously, the plastic surgeon dissects the free vascularized flap of the forearm (Figures 15.16 and 15.17). The creation of a phallus with a tube-in-a-tube technique is performed with the flap still attached to the forearm by its vascular pedicle (Figure 15.18). A small skin flap and a skin graft are used to create a corona and simulate the glans of the penis (Figure 15.19).

Once the urethra is lengthened and the vessels are dissected in the groin area, the patient is put into a supine position. The free flap can be transferred to the pubic area after the urethral anastomosis. Usually, the radial artery is microsurgically connected to the common femoral artery in an end-to-side fashion.

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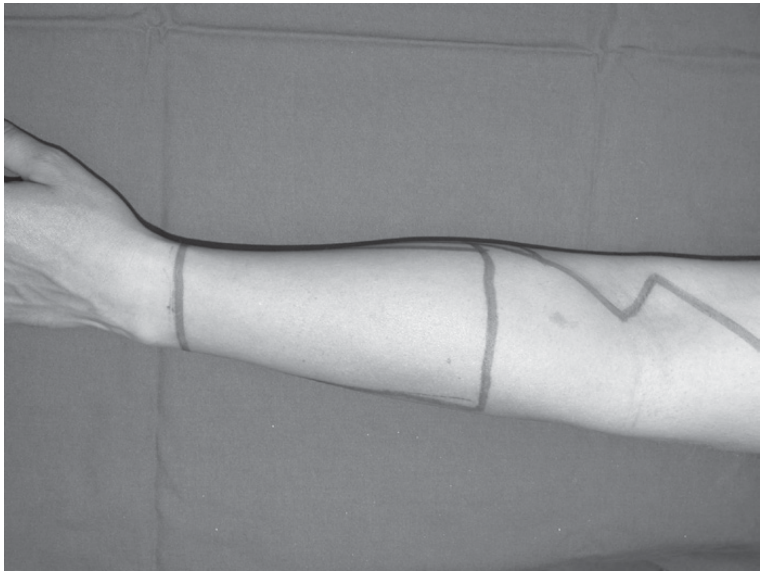

Figure 15.16 Phalloplasty with a radial forearm flap: design of the flap on the forearm.

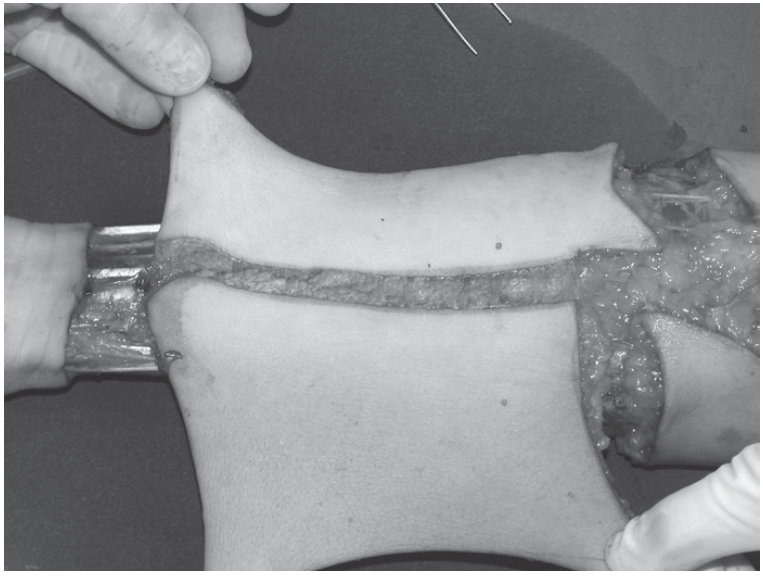

Figure 15.17 Phalloplasty with a radial forearm flap: urethral (longer) and penile part of the forearm flap are dissected.

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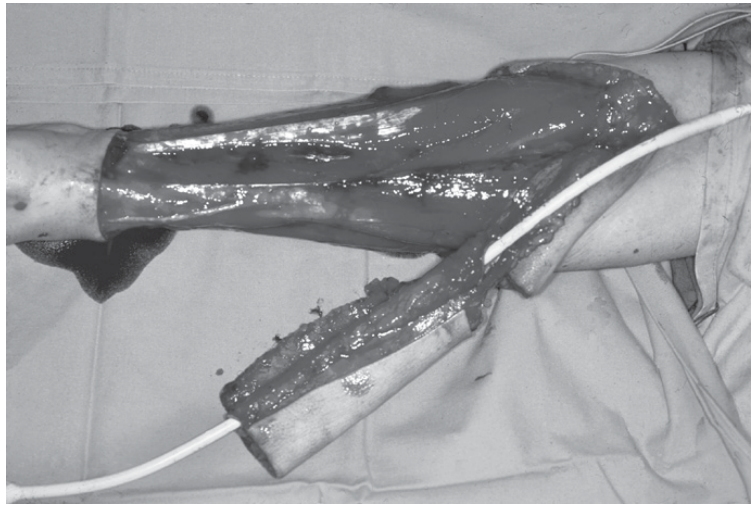

Figure 15.18 Phalloplasty with a radial forearm flap: creation of a urethral tube within a penile tube.

Figure 15.19 Phalloplasty with a radial forearm flap: immediate postoperative results.

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The venous anastomosis is performed between the cephalic vein and the greater saphenous vein. One forearm nerve is connected to the ilio-inguinal nerve for protective sensation and the other nerve of the arm is anastomosed to one of the dorsal clitoral nerves for erogenous sensation. The clitoris is usually denuded and buried underneath the penis, thus keeping the opportunity to be stimulated during sexual intercourse with the neophallus.

The defect on the forearm is covered with split-thickness skin grafts harvested from the medial and anterior thigh.

All patients receive a suprapubic urinary diversion postoperatively. The patients remain in bed for a 1-week postoperative period, after which the transurethral catheter is removed. At that time, the suprapubic catheter is clamped, and voiding is begun. Effective voiding may not be observed for several days. Before removal of the suprapubic catheter, a bladder scan is performed after voiding to make sure there is no residue.

The average hospital stay for the phalloplasty procedure is 2½ weeks. Tattooing of the glans can be performed after a 2–3-month period, before sensation returns to the penis (Figure 15.12).

Implantation of the testicular prostheses can be performed after 6 months, but it is typically done in combination with the implantation of penile erection prosthesis. Before these procedures are undertaken, sensation must have returned to the top of the penis. This usually does not occur for at least a year.

Pedicled Anterolateral Thigh Flap

Although the radial forearm flap is considered as the "gold standard" in penile reconstruction, the major drawback remains the wide circumferential scar on the forearm which, for transsexual individuals, can be pathognomic for their condition. We currently consider the ALT flap as the best alternative for patients who want to avoid a scar on the forearm (Figures 15.20 and 15.21). The ALT flap is a skin flap based on a perforator from the descending branch of the lateral circumflex femoral artery, which is a branch from the femoral artery. This flap has been used both as a free flap (Felici 2005) and as a pedicled flap (Ceulemans 2005).

The donor site is less conspicuous as it can be hidden underneath short pants and secondary corrections at that site are easier to make. In order to make the donor scar even less visible, tissue expanders can be used on both sides of the flap design prior to the phalloplasty procedure, enabling primary closure after harvesting the flap. However, since the ALT flap is not as thin or pliable as the radial forearm flap, a tube-within-a-tube construction is not possible. Therefore, a second flap is usually required for urethral reconstruction.

There are five options for urethral reconstruction:

1. a tube-within-a-tube technique (only to be used in extremely thin patients);
2. a pedicled groin or superficial circumflex iliac artery perforator flap (donor area can be closed primarily) (Figures 15.20 and 15.21);

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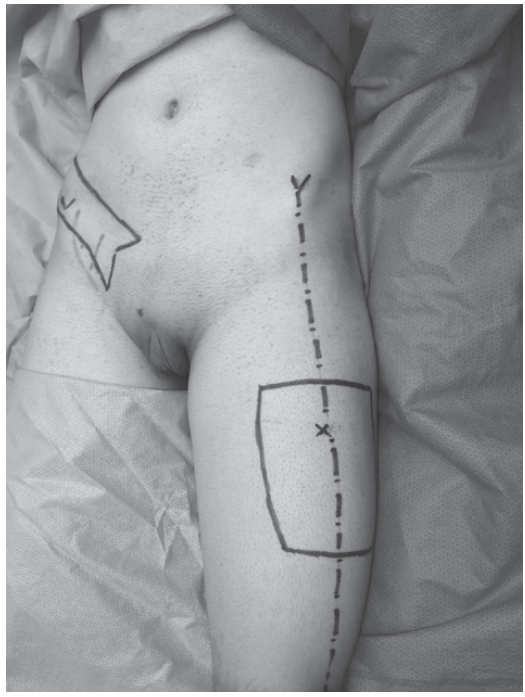

Figure 15.20 Phalloplasty with anterolateral thigh flap and superficial circumflex iliac artery perforator/groin flap: preoperative view.

Figure 15.21 Phalloplasty with anterolateral thigh flap and superficial circumflex iliac artery perforator/groin flap: postoperative view.

3. a small radial forearm flap (leaving a scar only on the inner, less exposed side of the forearm);
4. a prefabricated flap, using a skin graft on the inner site of the ALT, which then can be tubed and covered by the ALT flap as an outer tube;
5. tubed tissue of a previous, not functional phalloplasty.

Surgical Technique

Perforators are located using a preoperative angiocomputed tomography. They are usually located within a 3-cm radius circle at the midpoint of the line from the superior iliac spine to the lateral side of the patella. The flap is designed around these perforator vessels. After harvesting, the flap is tunneled underneath the rectus femoris muscle and transferred to the pubic area. The lateral femoral cutaneous nerve is transected after the flap has been harvested and reanastomosed to the clitoral/penile nerve and the ilio-inguinal nerve. The ALT flap is subsequently wrapped around the reconstructed urethra. The donor site of the ALT flap is closed with split-thickness skin grafts.

Alternative Techniques

Metoidioplasty

Metoidioplasty uses the clitoris to reconstruct the microphallus in a way that is comparable to the correction of chordee and lengthening of the urethra in a male pseudohermaphrodite, or in cases of severe hypospadias. Eicher (1989) prefers to call this intervention "the clitoris penoid." Care must be taken to avoid injury to the internal erectile tissues during removal of the fibrous bands, so as not to lose that important function.

In metoidioplasty, the clitoral hood is lifted and the suspensory ligament of the clitoris is detached from the pubic bone, allowing the clitoris to extend out further. When the tissues have been primed with testosterone, the clitoral head begins to resemble an adolescent glans penis. An embryonic urethral plate is divided from the underside of the clitoris to permit outward extension and a visible erection. The more developed the clitoris, the better the outcome of the metoidioplasty.

During metoidioplasty, the urethra is advanced to the tip of the new penis (Figure 15.22). This technique is very similar to the reconstruction of the horizontal part of the urethra in a normal phalloplasty procedure. Overweight patients may achieve greater length with pubic lipectomy, which will recess the body surface line.

During this same procedure, we usually perform a scrotal reconstruction, with a transposition flap of the labia majora (as previously described). In our hospital, this surgical intervention is also combined with a vaginectomy.

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Figure 15.22 Result of a metoidioplasty procedure.

Transmen interested in this procedure should be informed preoperatively that voiding while standing cannot be guaranteed, and sexual intercourse will not be possible.

The major advantage of metoidioplasty is the complete lack of scarring outside the genital area. Another advantage is that its cost is substantially lower than that of phalloplasty. Therefore, many patients opt for this procedure. Complications of a metoidioplasty may include urethral obstruction and/or urethral fistula.

It is always possible to perform a regular phalloplasty (e.g., with a radial forearm flap) at a later stage, and with substantially less risk of complications and operation time.

Fibular Flap

There have been several reports on penile reconstruction with the fibular flap based on the peroneal artery and the peroneal vein (Hage et al. 1996; Sadove et al. 1993). This consists of a piece of fibula which is vascularized by its periosteal blood supply and connected through perforating vessels to an overlying skin island at the lateral site of the lower leg. The advantage of the fibular flap is that it makes sexual intercourse possible without a penile prosthesis. The disadvantages are a pointed deformity to the distal part of the penis where the extra skin can glide around the end of fibular bone, and that a permanently erected phallus is impractical. However, there have also been

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some reports on the use of a fibular flap without bone to reconstruct a penis (D'Arpa personal communication; Schaff & Papadopulos 2009).

Many authors seem to agree that the fibular osteocutaneous flap is an optimal solution for penile reconstruction in a natal male (Sengezer et al. 2004).

Other Perforator Flaps

Other perforator flaps than the ALT flap include the thoraco-dorsal perforator artery flap and the deep inferior epigastric perforator artery flap. The latter might be an especially good solution for transmen who have been pregnant in the past. Using the perforator flap as a pedicled flap can be very attractive, both financially and technically.

External Prosthesis

For transmen who do not want any donor site morbidity, an external penile prosthesis can be a good alternative (Selvaggi et al. 2015). Although an external prosthesis has no functional benefit for voiding or sensation, it can result in a very satisfying aesthetic result.

The Future

Animal studies have shown the potential implementation of tissue engineering for penile reconstruction. Bioengineered tissue has been used for penile reconstruction in rabbits, who subsequently were able to successfully impregnate females (Chen et al. 2010; Yoo et al. 1999). Kim et al. (2002) suggest the future use of tissue-engineered human cartilage rods as penile prostheses.

Zhang et al. (2015) reported their experience with the use of vaginal mucosa in prefabricating the urethra in penile reconstruction. Due to its histological similarities, the vaginal mucosa can be a good substitute material for urethral reconstruction in total phalloplasty. Further research on this topic is necessary.

The Importance of a Multidisciplinary Approach

Gender reassignment, particularly reassignment surgery, requires close cooperation between the different surgical specialties. In phalloplasty, collaboration between the plastic surgeon, the urologist, and the gynecologist is essential (Monstrey et al. 2001). In the long term, the urologist's role may be the most important one for patients who have undergone penile reconstruction, especially because the complication rate is rather high, particularly with regard to the number of urinary fistulas and urinary stenoses. The urologist also reconstructs the fixed part of the urethra, and is likely the best choice for implantation of the penile and/or testicular prostheses. Later, the urologist must also address sequelae, including stone formation. The surgical complexity of adding an elongated conduit (skin tube urethra) to a biological female bladder, and the long-term effects of evacuating urine through this skin tube, demand lifelong urological follow-up.

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It bears repeating that the experience and skill of the surgeon who performs the erection prosthesis account for the resultant adequacy of sexual intercourse in more than 80% of cases (Hoebeke et al. 2003). Long-term follow-up is an absolute requirement, as the prosthesis is often implanted in a relatively young patient.

Therefore, professionals who unite for the purpose of creating a gender reassignment program should be aware of the necessity for a strong alliance between the plastic surgeon, the urologist, and the gynecologist. In turn, the surgeons must commit to the extended care of this unique population, which, by definition, will protract well into the future.

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10 Hormone Treatment of Adult Transgender People

Louis J. Gooren

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Introduction

As described elsewhere in this book, transsexualism is the condition in which a person with apparently normal somatic sexual differentiation is convinced that he or she is actually a member of the other sex. This conviction is accompanied by the irresistible urge to live in that preferred gender: hormonally, anatomically, legally, and psychosocially. The principles of hormone treatment of this population will be discussed herein.

General Principles of Treatment

The administration of cross-sex hormones to transgender people is, from the viewpoint of endocrinology, seemingly unorthodox. The indication is not based on technical endocrine grounds, such as a deficiency or excess of hormone action. Therefore, cross-sex hormone treatment has met with some reservations in professional circles, although acceptance is growing. For instance, the Endocrine Society has issued guidelines for treatment (Hembree et al. 2009).

The indication for treatment is the conclusion that sex reassignment will bring relief to an individual suffering from gender dysphoria—the extreme feeling often described as being "trapped in the wrong body." Although endocrine treatment is recommended by mental health professionals, it is the prescribing physician who retains responsibility for the intervention and the quality of care. It is important to maintain a close collaboration with the mental health professional. Medical practitioners are encouraged to follow the *Standards of Care* drafted by the international organization committed to professional assistance to transgender and transsexual people (Coleman et al. 2011). The major purpose of the *Standards of Care* is to articulate this organization's professional consensus opinion and available evidence about the psychological, medical, and surgical management of gender non-conforming conditions. These *Standards* provide guidance to professionals practicing in this area, around the world, many of whom work in isolation, far from mainstream medicine or endocrinology. The *Standards*

may also be useful in issues involving legal medicine, if it becomes necessary to identify professional standards. Persons with gender identity conditions and their families, as well as social institutions, can turn to the *Standards of Care* to understand the current thinking of professionals in this field. Before initiating hormonal or surgical treatments, the physician should counsel the patient regarding the following issues.

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Realistic Expectations of Treatment

The only benefit that sex reassignment can confer is relief of gender dysphoria; all human problems outside the arena of gender dysphoria will remain, although overall well-being usually improves (Ettner & Wylie 2013). Unrealistic expectations that persons may harbor concerning the impact of hormonal and surgical treatment on transition must therefore be addressed. Also, the limitations of cross-sex hormone administration in adult, and certainly elderly, patients, should be frankly discussed. After years of silent suffering and loneliness, fantasy can often supersede reality. Contact with others who are in the process of transition, or who have completed this process, can be quite helpful in shaping a person's expectations of what can be reasonably achieved with hormonal and surgical treatment. Likewise, the problems—personal, professional, and social—that may arise, both initially and long-term, can often be averted. It is important to realize that somatic treatment of transgender patients—both endocrinological and surgical—is rehabilitative rather than curative. Consequently, quality of life for reassigned persons will definitely improve, but will be characterized by certain limitations, similar to the medical treatment of many congenital conditions.

Hormonal Gender-Affirming Therapy

The acquisition of the secondary sex characteristics of the other gender, to the fullest extent possible, is fundamental to sex reassignment for the transsexual patient. Obviously, acquisition of these secondary sex characteristics is contingent on sex steroids. There is no known essential difference in sensitivity to the biological action of sex steroids on the basis of genetic configurations or gonadal status. Adults undergoing sex reassignment have the disadvantage that, by adulthood, several years of hormonal masculinization or feminization have already occurred.

Unfortunately, the elimination of these hormonally induced natal sex characteristics is rarely complete. In male-to-female transsexual patients, the previous effects of androgens on the skeleton (average greater height; size and shape of hands, feet, and jaw; and pelvic structure) cannot be reversed by hormone treatment. Conversely, the relatively short stature in female-to-male patients as compared to natal males (on average 12 cm), and the often broader hip configuration, will not change with androgen treatment. These features, however, show considerable overlap between the sexes, more so in some races than in

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others. Thus, for some individuals, characteristics of the natal sex will be comparatively less visible than for others.

The typical adult requesting treatment is a young to middle-aged healthy person and, therefore, there are few absolute or relative contraindications against cross-sex hormone administration. Relative contraindications for estrogen use are a strong family history of breast cancer, personal history of thromboembolic disease, or the presence of a prolactin-producing pituitary tumor. Relative contraindications for androgen use are hormone-dependent cancers or severe lipid disorders with cardiovascular complications. Caution must be used with sex steroid administration when there is serious cardiovascular, cerebrovascular, or thromboembolic disease, or with marked obesity, poorly controlled diabetes mellitus, or serious liver disease (Gooren 2011; Hembree et al. 2009).

It is advisable to discontinue sex steroid administration 3–4 weeks prior to any elective surgical intervention. Immobilization is a thrombogenic risk factor, and sex steroids may aggravate the risk of thromboembolism. Like other patients on sex steroid replacement, once fully mobilized following the surgical procedure, the patient may resume hormone therapy.

Treatment of Male-to-Female Patients

For the male-to-female transsexual individual, elimination of body hair growth, induction of breast formation, and a more female fat distribution are essential. To accomplish these goals, a near-complete reduction of the biological effects of androgens is required. Administration of estrogens alone will suppress gonadotropin output and therefore androgen production, but dual therapy with a compound that suppresses androgen secretion or action, and a second compound that supplies estrogen, is more effective.

For suppression of androgen secretion or action, several agents are available. In Europe, the most widely used drug is cyproterone acetate (usually 50 mg twice daily), a progestational compound with antiandrogenic properties. If that is not available, then medroxyprogesterone acetate, 5–10 mg/day, is a less effective alternative. Spironolactone (up to 200 mg twice daily, if tolerated), a diuretic with antiandrogenic properties, has similar effects, and is widely available. Long-acting gonadotropin-releasing hormone agonists, injected monthly, also inhibit gonadotropin secretion. Finasteride (5 mg/day), a 5-alpha-reductase inhibitor, might also be considered (Gooren 2011; Hembree et al. 2009) on the basis of its pharmacological action—inhibition of the conversion of testosterone to 5-alpha-testosterone. This is less useful when testosterone is already profoundly suppressed by other pharmacological interventions such as combined antiandrogens plus estrogens.

Estrogen

A wide range of estrogens is available. Oral ethinyl estradiol (50–100 μg/day) is a potent and inexpensive estrogen, but may cause venous thrombosis,

particularly in those over 40 years of age (Asscheman et al. 2014; Toorians et al. 2003). Furthermore, it has been implicated in elevated cardiovascular mortality (Asscheman et al. 1989). Ethinyl estradiol should not be used any more. Oral estradiol, 2–4 mg/day, or transdermal 17β-estradiol, 100 μg delivered continuously per day changed once or twice a week, are the treatments of choice, and are much less thrombogenic than ethinyl estradiol (Toorians et al. 2003). Many people prefer injectable estrogens as they generate high levels of circulating estrogens. However, they have the potential risk of overdose and, if an emergency were to occur that required discontinuation of estrogens, it would be impossible to get rid of the long-lasting effects of depot estrogen injections. Injections of estradiol may be considered if circulating estradiol levels cannot be achieved despite reaching maximal doses of oral estradiol.

No evidence suggests that progestogens (progestins) add to the feminization process. In female reproductive endocrinology, progesterone prepares the uterus for conception, and the breasts for lactation. Some patients strongly believe that progestogens are a necessary addition to estrogens in their feminization (Wierckx et al. 2014). They should be informed not only that this is not the case, but also that progestogens may have side effects, such as salt/water retention, leading to elevated blood pressure or venous varicoses. In a large-scale study of postmenopausal hormone use in women, the combination of estrogens and progestagons appeared to be associated with a higher incidence of breast cancer and cardiovascular disease (Gooren et al. 2014), providing yet another reason to advise against their use.

Results of Hormone Therapy for Male-to-Female People

Results of hormonal therapy are as follows.

BODY HAIR

There is a reduction in body hair growth; hair becomes thinner and loses its pigment. But adult male beard growth is very resistant to inhibition, even with the combined hormonal intervention of antiandrogens plus estrogens. In Caucasian individuals, additional measures to eliminate facial hair are necessary, such as electrolysis or laser treatment. Hair growth on other parts of the body responds more favorably to hormonal intervention, and will usually be markedly reduced after 1 or 2 years of cross-sex hormone treatment (Giltay & Gooren 2000). Some Asian subjects have little or no secondary sexual hair and administration of antiandrogens may not be necessary (Gooren 2014).

BREAST DEVELOPMENT

Breast formation starts almost immediately after initiation of cross-sex hormone administration and proceeds with periods of growth and plateau (Wierckx et al. 2014). As androgens have an inhibitory effect on breast

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formation, estrogens will be most effective in a low-androgen milieu, which is usually achieved with the combination of cyproterone acetate or spironolactone and estrogens. After 2 initial years of full hormone administration, no further development can be expected (Wierckx et al. 2014). Older age also impedes full breast formation. About 50–60% of the hormone-treated subjects report satisfaction with breast volume, while the remaining 40–50% judge their breast development as insufficient. The attained size, in itself a measure of success of cross-sex hormone administration, is often disproportional to the greater height and dimension of the chest of adult male-to-female transsexual individuals. The latter group will often seek surgical breast augmentation.

SKIN

Androgen deprivation leads to a decreased activity of sebaceous glands, which may result in dry skin or brittle nails, sometimes requiring protection from detergents and/or local application of hydrating creams (Giltay & Gooren 2000).

BODY COMPOSITION

Following androgen deprivation, there is an increase in subcutaneous fat, and a decrease in lean body mass. Body weight usually increases but can be controlled with dietary measures.

TESTES

Lacking gonadotropic stimulation, the testes become atrophic. In rare cases, they may enter the inguinal canal, and cause discomfort.

PROSTATE

Androgen deprivation leads to atrophy of the prostate and a change in the anatomical condition of the bladder neck, which may produce transient dribbling following micturition. This complaint usually disappears in the course of 1 year.

VOICE

Antiandrogens and estrogens have no effect on the properties of the voice. Some individuals may wish to consult a specialized phoniatric center for speech therapy. Maleness of the voice is not so much determined by the pitch of the voice as by chest resonance and volume. Speech therapy may lead to more feminine speech and speech patterns (Cosyns et al. 2014). Laryngeal surgery may change the pitch of the voice, but will also reduce the range.

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LONG-TERM THERAPY

After reassignment surgery, including orchiectomy, hormone therapy must be continued. Some patients still exhibit male-pattern hair growth, and experience teaches that antiandrogens may remain effective in reducing it, although the dose may be lowered. Continuous estrogen therapy is required to avoid symptoms of hormone deprivation and, most importantly, to prevent osteoporosis (Van Caenegem et al. 2012). We have found that estrogens alone, adequately dosed, are capable of maintaining bone mass in male-to-female transsexuals. There was an inverse relationship between serum luteinizing hormone concentrations and bone mineral density, suggesting that serum luteinizing hormone may serve as an indicator of the adequacy of sex steroid administration (Van Kesteren et al. 1998). There is, as yet, no consensus as to the age until which cross-sex hormone must be continued. Transgender patients usually favor maintenance of hormones throughout the later years. There are no data to support or dismiss this treatment policy (Gooren & Lips 2014). Perhaps a parallel can be drawn with women who receive postmenopausal estrogen replacement, but that regimen rarely extends beyond the late 50s.

Treatment of Female-to-Male Patients

The goal of treatment in the female-to-male patient is to induce virilization (including a deepening of the voice), production of male-pattern body hair growth and physical contours, and cessation of menses. The principal hormonal treatment used to accomplish these goals is a testosterone preparation. The most commonly used preparations are testosterone esters, an injectable that is administered intramuscularly in doses of 200–250 mg every 2 weeks. In some countries, testosterone undecanoate (1,000 mg) is available, and injections may be spaced at 10–12 weeks. Some clinicians favor weekly injections of lower doses of testosterone in order to avoid the variation in serum testosterone levels that can occur with other programs. Use of androgen gel or transdermal patches can also provide good, steady-state levels, and can be used by the patient at home.

Regardless of the vehicle of administration, serum testosterone levels should be evaluated periodically to guard against prolonged administration of supraphysiologic doses, known to have deleterious effects in men. Occasionally, menstrual bleeding does not cease, and the addition of a progestational agent is necessary. If a transdermal or oral testosterone preparation is used, addition of a progestational agent is nearly always required to stop menstrual bleeding, which is experienced by patients as an unpleasant reminder of the sex they wish to relinquish.

Results of Hormone Therapy for Female-to-Male People

The many results of hormonal therapy in this population are as follows.

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HAIR

The development of body hair essentially follows the pattern observed in pubertal boys, appearing first on the upper lip, then the chin, then the cheeks (Giltay & Gooren 2000). The degree of facial and body hair can usually be predicted by the extent and pattern existing in their male family members. This also applies to the occurrence of androgenetic alopecia, which will affect approximately 50% of the patients to some degree. There is no association between type of androgen used, be it injections, transdermal, or oral agents, and this outcome.

ACNE

Acne occurs in approximately 40% of those treated, and usually appears more pronounced on the back than the face. This has also been observed in hypogonadal men who start androgen treatment past the age of normal puberty. This can usually be remedied with conventional antiacne treatment.

VOICE

Deepening of the voice starts after 6–10 weeks of androgen administration and is irreversible.

FAT

Androgen administration leads to a reduction of subcutaneous fat, but an increase in abdominal fat. The increase in lean body mass is, on average, 4 kg, and the increase in body weight is usually greater (Elbers et al. 1999). Although weight gain is associated with androgen use, it is certainly possible to control it with dietary measures.

CLITORAL ENLARGEMENT

Clitoral enlargement occurs in all transmen, but the degree varies. In approximately 5–8%, the size becomes sufficiently large for vaginal intercourse.

LIBIDO

Most patients report an increase in libido, and this is rarely experienced as bothersome or disruptive.

OVARIES

Ovaries show polycystic changes (Ikeda et al. 2013), and androgen administration may decrease glandular activity of the breasts (Slagter et al. 2006). It does not, however, reduce breast size.

After bilateral oophorectomy, androgen therapy must be continued to maintain virilization and prevent osteoporosis (Van Caenegem et al. 2012). Suppression of the serum luteinizing hormone concentration to within normal range can be used as an indication of the efficacy of androgen administration.

Side Effects of Hormonal Sex Reassignment

Administration of cross-sex hormones may have side effects, with hormone-dependent tumors being of particular concern. Overall, cross-sex hormone treatment is acceptably safe (Meriggiola & Berra 2012). A study in 2011 reported on the Amsterdam (the Netherlands) gender clinic on 966 transwomen and 365 transmen treated with cross-sex hormones for 1–20 years (Asscheman et al. 2011). In the group of transwomen, total mortality was 51% higher than in the general population, mainly from increased mortality rates due to suicide, acquired immunodeficiency syndrome, cardiovascular disease, drug abuse, and unknown cause. No increase was observed in total cancer mortality, but lung and hematological cancer mortality rates were elevated. Current, but not past, ethinyl estradiol use was associated with an independent threefold increased risk of cardiovascular death. In the group of transmen, total mortality and cause-specific mortality were not significantly different from those of the general population (Asscheman et al. 2011). Another study noted increased cardiovascular disease as well as decreased bone mineral density in transwomen (Wierckx et al. 2012).

Venous Thromboembolism

The incidence of side effects of this nature was 2–6% in male-to-female people treated with oral ethinyl estradiol (Asscheman et al. 2014; Van Kesteren et al. 1997). In vitro studies show that this thrombogenic effect is typical of oral ethinyl estradiol but not of oral 17β-estradiol valerate or transdermal estrogens (Toorians et al. 2003). Because immobilization is also a risk factor for venous thromboembolic events, estrogen admnistration should be discontinued for 3–4 weeks before elective surgical interventions. Once patients are fully mobilized following these procedures, estrogen therapy may be resumed (Asscheman et al. 2014).

Atherosclerosis

Although the considerable sex difference in the prevalence of cardiovascular disease between men and women would lead one to expect an effect of hormonal treatment, the actual risk remains to be established. The effects of estrogen administration in transwomen and androgen administration in transmen on biochemical risk markers have been studied (Gooren & Giltay 2014). It appears that estrogen administration has more negative effects on these risk markers than do androgens (Gooren et al. 2014). Genetic factors may

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play a role (Gooren et al. 2014). But long-term studies with clinical endpoints are needed to fully assess the effects of cross-sex hormones on cardiovascular risk. In our study, cardiovascular disease became more manifest as transpeople age (Gooren et al. 2014), and cardiovascular risks should be treated aggressively in elder transgender people. Smoking should be strongly discouraged.

It should be noted that dosages used in transgender individuals are often much higher than those used in hormone replacement for hypogonadal patients (Gooren et al. 2014; Wierckx et al. 2012).

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Lactotroph Adenoma

Several cases of lactotroph adenoma (prolactinoma) following high-dose estrogen administration have been reported in patients with normal serum prolactin concentrations before therapy (Cunha et al. 2015). A case of a pituitary microprolactinoma developed in a transwoman after 14 years of normal-dose estrogen treatment (Bunck et al. 2009). Although causality has not been established, we recommend that serum prolactin levels continue to be monitored long-term in estrogen-treated transwomen at 1–2-year intervals.

Breast Cancer

The number of cases of breast cancer in transsexual people is increasing. A new aspect is that transmen may develop breast cancer as well, even though they have had breast ablation. Cancer may occur in residual mammary tissue (Gooren et al. 2013). Fortunately, prevalence remains rather low. In Veterans Health Administration data from 5,135 transgender veterans in the United States from 1996 to 2013, ten breast cancer cases were confirmed. Seven were in transmen and three in transwomen veterans. Breast cancer in transgender people may occur at a relatively young age and after a relatively short period of exposure to cross-sex hormones. Even though relatively rare, patients should be taught self-examination of the breasts, particularly when there is a family history of breast cancer. Increased risk of breast cancer due to, e.g., *BRCA1* or *BRCA2* mutations may be present in these individuals, and ablation of breast tissue before hormone therapy may be considered (Colebunders et al. 2014).

Benign Prostate Hyperplasia

The prostate is not removed with sex reassignment surgery. Prostatectomy is a surgically cumbersome operation, with possible complications, such as urinary incontinence. As expected, the prostate volume shrinks after androgen deprivation. Estrogen exposure does not induce signs of hyperplasia or (pre) malignancy (Van Kesteren et al. 1996). One case of benign prostate hyperplasia, requiring transurethral prostate resection, has been described (Brown & Wilson 1997). Epidemiological studies have shown that orchiectomy before the age of 40 years prevents the development of prostate cancer and benign prostate

hyperplasia. The individual in this case was over 40 years of age when starting cross-sex hormones. One case of obstructive enlargement of the verumontanum, appearing 25 years after initiation of cross-sex hormones and requiring resection of the verumontanum, has also been reported (Goodwin & Cummings 1984). Urological problems after sex reassignment of transwomen have been reviewed (Hoebeke et al. 2005). In transmen who have undergone genital surgery, urethral fistulae, urethral strictures, and meatal stenosis with an incidence of >30% have been observed, requiring surgical treatment (Lumen et al. 2011).

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Prostate Cancer

Prostate cancer in transwomen has recently been reviewed (Gooren & Morgentaler 2014). It is not clear whether these cancers are estrogen-sensitive, or whether they were present prior to beginning estrogen administration and then subsequently de-differentiated to become androgen-independent. These patients were each beyond 50 years of age when they initiated cross-sex hormone treatment (resulting in total androgen ablation). As previously indicated, epidemiological studies have shown that orchiectomy before the age of 40 prevents the development of prostate cancer and benign prostate hyperplasia (Wilson & Roehrborn 1999), and the aforementioned cases do not contradict this notion. In most clinics, screening for the development of levels of prostate-specific antigen is not routinely done, but it may be in those with a family history of prostate cancer, starting at the age of 50 years. Due to antiandrogen treatment, the cut-off level for prostate-specific antigen should be set at the much lower level of 1 ng/mL.

Ovarian Cancer

We recently observed two cases of ovarian carcinoma in long-term, testosterone-treated transmen. The ovaries of female-to-male patients taking androgens resemble polycystic ovaries (Spinder et al. 1989), which are also more prone to develop malignancies. Therefore, it seems reasonable to remove the ovaries of androgen-treated female-to-male patients after transition. In several countries, sex reassignment treatment is not covered by health insurance schemes. This may delay the surgical removal of ovaries, thereby increasing the risk of malignant degeneration.

Sexual Function After Surgery

Little attention has been given to the subject of sexual functioning in the postoperative person, and the scant available research has been largely based on self-reports. As expected, there is a correlation between sexual function and the quality of the neovagina, neoclitoris, or neophallus (Klein & Gorzalka 2009). While not all postoperative patients are orgasmic, many report sexual satisfaction.

A hormonal factor to consider in sexual health may be the almost complete, pharmacologically induced androgen depletion that occurs in transwomen. The circulating androgen levels are lower in these cases than in cases involving non-transgender women. It is becoming clear that low levels of androgens in women are important for female libido and sexual enjoyment. Occasionally, the drug for postmenopausal women, tibolone, can be successfully employed, but this information is anecdotal. Low-dose testosterone therapy was shown to be successful (Kronawitter et al. 2009). By contrast, transmen receiving androgen therapy usually experience an increase in sexual interest (Costantino et al. 2013; Wierckx et al. 2011). More research is needed to shed light on the sexual functioning of postoperative individuals, and how to maximize sexual health and pleasure.

Regrets After Surgery

Given the irreversibility of sex reassignment surgery and, to a lesser degree, of cross-sex hormone administration, it is very valuable to have insight into factors that foretell success or failure. Prospective controlled studies specifically designed to assess outcome and its prognostic factors are methodologically difficult, and absent in the literature. It has been estimated that 1–2% of those undergoing reassignment will have regrets (Pfafflin 1992). Some of these individuals have experienced gender dysphoria late in adult life, without strong manifestations in childhood; others have difficulty in transitioning to the preferred gender because of their appearance or limited social skills.

Therefore, the importance of social role transition cannot be overemphasized. People must be encouraged to discuss their doubts and ambivalence with a mental health professional. Celebrating successes in the adaptation process also encourages a consolidation of identity in the postoperative period and beyond. The quality of the surgical construction of the genitalia is extremely important in successful postsurgical satisfaction. Indeed, this factor alone, whether the surgery is aesthetically and functionally sound, often differentiates those who regret having undergone sex reassignment from those who thrive in their new status (Lawrence 2003).

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Hormone Therapy for Transgender Women

7

Vin Tangpricha and Joshua D. Safer

Introduction

Sex steroid hormones play an important role in gender-confirming therapies of transgender women to modify the external physical appearance to align with gender identity. Most transgender women seeking gender-confirming surgeries will be taking gender-confirming sex steroid hormone therapy. Under medical supervision, hormone therapy appears to be safe with very low risk of complications [3]. However, some patients may be receiving hormone therapy without a prescription or routine medical monitoring which may lead to increased risk of complications [2]. Surgeons and physicians and other healthcare providers should understand and recognize the goals of gender-affirming hormone therapy and potential pitfalls during the pre-, peri-, and postoperative period of gender-confirming surgery which will be covered in this chapter.

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Principles of Hormone Therapy

The overall goal of gender-affirming hormone therapy for a transfeminine person is to lower the circulating blood testosterone concentrations to a female range (<50 ng/dL) and to raise the estradiol concentrations to a premenopausal female range [4, 5]. Lowering of testosterone concentrations is an important priority in the hormone therapy as inadequately suppressed concentrations of testosterone will not allow for optimal feminization with estrogen regimens [6].

The physician should consider the age, hormonal status, and medical conditions of the transgender woman at the initiation of gender-confirming hormonal therapy. Younger patients who have undergone pubertal suppression followed by gender-affirming hormone therapy may require lower doses of sex steroid hormones to maintain secondary sex characteristics in adulthood. Older patients may have conditions that could be exacerbated by hormone therapy. The physician and transgender person should discuss all of the potential risks, benefits, and anticipated time course of emotional and physical changes occurring and suggested monitoring and screening for adverse events during hormone therapy.

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Treatment Regimens

There are two broad classes of hormone regimens: [1] estrogen therapies and [2] testosterone-lowering therapies. Standard hormone regimens have been published in the Endocrine Society Guidelines for Transgender and Gender Non-Conforming Persons [3]. Estrogen can be given orally, transcutaneously, or by parenteral injection (Table 7.1). Most common in the United States are estradiol tablets due to its cost and ease of use. Transcutaneous forms of estrogen include estradiol gels and patches. Estrogen gels can be more expensive and have issues with potential cutaneous transfer to other individuals. Estrogen patches can have issues with skin reactions to the adhesive and/or issues with adhering to the skin. Estradiol shots require additional patient instruction on the proper injection technique and may result in supraphysiologic levels of estradiol if they are not taken as prescribed.

Spironolactone is the most commonly prescribed testosterone-lowering medication in the United States. Spironolactone is an antihypertensive and diuretic medication that also has direct actions on decreasing testosterone synthesis and action. Common adverse events with spironolactone include mild nausea, orthostasis, polyuria, and mild hyperkalemia. GnRH agonists are very effective testosterone-lowering medications. They act by decreasing the production of gonadotropins and thus decrease gonadal synthesis of testosterone. GnRH agonists can be given intramuscularly monthly or every 3 months or by subcutaneous pellet for 1–2 years. The major barrier that limits the use of GnRH agonists is the costs of the medication which are not typically covered by insurance. Cyproterone acetate is an oral progestin that can be used for its antiandrogen-like activity. This agent is more commonly used in Europe and is not available in the United States. The drug class of the 5α-dihydrotestosterone (5α-DHT) inhibitors is not recommended for several reasons. First, they do not lower testosterone concentrations. Also, these agents have been associated with sexual dysfunction and mood disorders [7]. Some physicians may consider prescribing DHT inhibitors in transgender women who to have male pattern hair loss despite good suppression of testosterone concentrations although there are no data for benefit among individuals with testosterone levels in the female range.

Long-Term Monitoring and Potential Adverse Events

Transgender women experience very few long-term adverse events when followed by a medical professional (Table 7.2) [1]. However, thrombo-

Table 7.1 Estradiol regimens for transfeminine persons

Estrogen-based regimens[a]			
Drug name	Route	Dose range	Comments
Estradiol	Orally	1–6 mg daily	Widely available Inexpensive
Estradiol patch	Cutaneously	0.025–0.2 mg daily	Applied weekly or biweekly
Estradiol gel 0.06%	Cutaneously	1–3 pumps daily	Avoid skin transfer
Estradiol valerate	Intramuscularly	10–20 mg q1–2 wks	Requires close monitoring to avoid supraphysiologic levels

Testosterone-lowering regimens[b]			
Drug name	Route	Dose range	Comments
Spironolactone	Orally	50–400 mg daily	Has diuretic effects Hyperkalemia possible Use with caution in CKD
Cyproterone	Orally		Not available in the USA
GnRH agonists	Intramuscularly or subcutaneous pellet	Varies by duration	More expensive

[a]Synthetic estrogens not recommended

[b]5α-dihydrotestosterone (5α-DHT) inhibitors not routinely recommended as they do not lower testosterone

Table 7.2 Suggested monitoring for transgender women

1. Clinical assessment and laboratory monitoring for estradiol and testosterone levels every 3 months for the first year then twice yearly
2. Monitoring of potassium concentrations upon initiation of spironolactone and with dose changes (every 3 months for the first year), then once or twice yearly
3. Baseline assessment of prolactin concentration and periodic measurement of prolactin
4. Measurement of bone mineral density in patients with risk factors for osteoporosis including gonadectomy, personal history fracture, family history of osteoporosis, low BMI, tobacco, or alcohol misuse
5. Screening for hormone-sensitive cancers such as prostate and breast cancer should follow age-specific recommendations by national societies

Adapted from the Endocrine Society Guidelines

Table 7.3 Potential adverse events from gender-confirming hormone therapy in transgender women

High risk
Thromboembolism
Moderate risk
Abnormalities in liver function tests
Hyperprolactinemia
Migraine headaches
Elevated triglycerides
Weight gain
Low risk to unknown
Hormone-sensitive cancers
Cardiovascular disease

Adapted from the Endocrine Society Guidelines

embolism still remains the most serious complication of estrogen therapy among transgender women, which is estimated to occur in 1–5% of transgender women in their lifetime (Table 7.3) [8]. Factors that increase risk are supraphysiologic levels of estradiol, the formation of the estrogen (with estradiol being the safest) [9], the route of the estrogen (transdermal being the safest) [10], older age, smoking status, postoperative status [11], and obesity (BMI > 27) [12]. Physicians should counsel transfeminine patients to quit smoking, maintain a healthy weight, avoid supraphysiologic levels of estradiol, and consider a switch to transdermal estrogen with advancing age [13]. Patients should be made aware of the risks of thromboembolism, counseled on how to recognize the signs, and advised to seek treatment immediately. There are no current guidelines for screening of asymptomatic transgender women for thromboembolic disease.

Osteoporosis has been reported to be a concern in transwomen with 1 out of 8 transwomen presenting with T-scores < −2.5 at any site prior to the initiation of hormone therapy [14]. The reason for the low bone density in transwomen is not clear but may be due to decreased physical activity and lower vitamin D status [12]. Adequate replacement with estrogen is very important to preserve bone mass especially after gonadectomy [15]. Very few fractures have been reported among transgender women, and it is not currently known if the rates of fracture are higher compared to the general population [16]. Transgender women should be screened for osteoporosis by DEXA after age 50 or sooner if there are risk factors present for osteoporosis (family history of fractures, glucocorticoid use, smoking, or alcohol misuse).

Liver function test abnormalities can occur transiently in up to 5% of transgender women but does not result in permanent liver disease [17]. Therefore, routine testing of liver function tests is no longer recommended.

Breast and prostate cancers are of concern in transgender women, but there is insufficient evidence that supports an increased or decreased rate after hormone therapy [18]. Most of the literature on this topic comes from small case reports [16]. The largest study examining breast cancer conducted among military veterans identified 10 cases of breast cancer among 5135 transgender veterans [19]. This rate was not increased compared to the expected incidence of cancer in this population. The Endocrine Society currently recommends cancer screening based on the age-appropriate screening guidelines for the remaining hormone-sensitive organs [3]. There is no current evidence to screen at earlier ages in the transgender population.

Transgender persons have a higher rate of depression and anxiety compared to the general population [20]. Transgender persons seeking care at the Veterans Affairs healthcare system have increased mortality related to suicide

compared to non-transgender veterans and the general population [21]. Studies have indicated that hormone therapy in transgender persons improves quality of life and mood disorders, but the rate of depression and anxiety still remained elevated [22, 23]. Physicians should continue to screen for depression and mood disorders at each visit and refer patients to qualified mental health specialists for evaluation if mood disorders are present.

Surgical Considerations

Most transgender women who seek gender confirmation surgery will be on hormone therapy with estrogen and a testosterone-lowering agent. It is the responsibility of the surgeon to obtain letters of referral according to the World Professional Association for Transgender Health (WPATH) guidelines [24]. For breast reconstruction surgery, the current WPATH guidelines recommend a referral letter without a minimum amount of time on hormone therapy. For gonadectomy surgery (oophorectomy or orchiectomy), the WPATH guidelines recommend 2 referral letters and that the transgender woman be on hormones for at least 12 months prior to surgery. Finally, for gender-confirming genital surgery, the WPATH guidelines recommend 2 referral letters, 12 months of continuous hormone therapy, and 12 months living in the desired gender role.

The surgeon should review the patient's past medical history and obtain the appropriate consultations for any chronic medical illnesses that may impact the surgery and/or postoperative recovery. The surgeon should verify that the hormone regimen is appropriate and may need to communicate with the hormone-prescribing physician. Hormone regimens that appear to be supraphysiologic or non-standard may require a perioperative assessment by an endocrinologist with experience in transgender medicine.

Since estrogen has been associated with increased risk of thromboembolism, most centers will hold estrogen therapy 2–4 weeks prior to surgery although there are no data for such a need. It may also be appropriate to check estradiol levels prior to surgery to ensure that levels are not supraphysiologic. It is most important to ensure that all patients have adequate postoperative DVT prophylaxis and that patients do not reinitiate on estrogen therapy until they are fully ambulatory after surgery. After gonadectomy surgery, testosterone-lowering agents can be stopped.

Following gonadectomy and/or gender-confirming genital surgery, transgender women should have a reassessment of their hormone levels with serum estradiol and testosterone values. The testosterone levels should be nearly undetectable and no longer need to be measured following gonadectomy. Following gonadectomy surgery, estrogen doses may be lowered as long as serum estradiol levels are maintained in the female range.

Conclusions

Most transgender women will take gender-confirming hormone therapy prior to undergoing gender-confirming surgery. The most common regimens include an estrogen taken together with a testosterone-lowering agent. The risks of gender-confirming hormone therapy are low, especially when prescribed under medical supervision. Transgender women should stop taking gender-confirming hormone therapy for a period of time prior to gender-confirming surgery and then resume hormone therapy once ambulatory after the surgery. Long-term risks of gender-confirming hormone therapy appear to be low; however, large prospective cohort studies are needed to measure the long-term risks of therapy [25].

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8 Hormone Therapy for Transgender Men

Joshua D. Safer and Vin Tangpricha

Introduction

Like transgender women (Chap. 7), sex steroid hormones play an important role in gender-confirming therapies of transgender men to modify the external physical appearance to align with gender identity. Most transgender men seeking gender-confirming surgeries will already have started gender-confirming sex steroid hormone therapy. Under medical supervision, hormone therapy appears to be safe [1]. The surgeon should be aware that some patients may receive hormone therapy without a prescription or routine medical monitoring, which may lead to increased risk [2]. Surgeons and other health-care providers should understand the goals of gender-affirming hormone therapy along with its potential pitfalls.

Principles of Hormone Therapy

The overall goal of gender-affirming hormone therapy for a transmasculine person is to raise the circulating blood testosterone concentrations to a male range (300–1000 ng/dL) [3–5].

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The physician should consider the age, hormonal status, and medical conditions of the transgender man at the initiation of transgender hormone therapy. The physician and transgender person should discuss all of the potential risks, benefits, the anticipated time course for emotional and physical changes to occur, and suggested monitoring and screening for adverse events during hormone therapy.

Treatment Regimens

Typically, hormone treatment for transgender men consists of testosterone to bring the serum testosterone level from the female range to the male range. The doses required are similar to those used for treatment of hypogonadal males in general (Table 8.1). Testosterone is administered parenterally (either intramuscularly or subcutaneously) or transdermally (via gel or patch).

Parenterally administered testosterone preparations include testosterone enanthate and testosterone cypionate. Both formulations can be administered intramuscularly or subcutaneously [6]. Dosing intervals range from 1 to 3 weeks with less periodicity in serum levels with shorter intervals. Where available, longer-acting testosterone undecanoate permits administration only every 8–12 weeks.

Transdermal testosterone products include both gels and patches. Both can be considered attractive because they can provide stable serum

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Table 8.1 Testosterone regimens for transmasculine persons

Parenteral regimens		
Drug name	Route	Dose range
Testosterone enanthate	IM or SQ	50–200 mg every 1–3 weeks
Testosterone cypionate	IM or SQ	50–200 mg every 1–3 weeks
Testosterone undecanoate	IM	1000 mg every 8–12 weeks

Transdermal regimens		
Drug name	Route	Dose range
Testosterone gel 1.6%	Cutaneously	1–4 pump actuations (50–100 mg) daily
Testosterone patch	Cutaneously	2.5–7.5 mg daily

levels with less periodicity than parenterally administered products. However, the transdermal products suffer from relatively inefficient transdermal transfer. Some individuals may be unable to achieve therapeutic serum levels with transdermal products. As well, individuals using transdermal gels may accidentally deliver doses to others if they come into skin-to-skin contact with the area where the dose was applied too soon after application. Patches are often not well-tolerated due to cutaneous irritation.

Testosterone is aromatized to estradiol in peripheral tissues, specifically in fat. Some patients express concern that exogenous testosterone will be aromatized to supraphysiological levels of estradiol. However, there are no data for such an event when physiologic doses of testosterone are used. Therefore, there is no known purpose for adjunctive aromatase-inhibiting therapy.

Clinical expectations from treatment include absence of menses after several months at therapeutic levels, increased facial hair developing slowly over months and years, and increased acne especially early in treatment. Over the years, muscle and fat may redistribute into more masculine patterns including larger muscles and more omental fat. Testosterone also stimulates growth of midline structures over multiyear periods. Treated individuals can anticipate slow growth in the area of the nose, the larynx, and the phallus/clitoris with substantial virilization of the latter given enough time.

Long-Term Monitoring and Potential Adverse Events

The typical monitoring regimen includes indicated examination and laboratory testing every 3 months when making changes to the regimen and then every 6–12 months thereafter. Usual monitoring includes serum testosterone (to determine success of therapy), hematocrit, and lipid profile.

The biggest concerns for testosterone therapy are an increase in hematocrit (with a potential increased thrombosis risk) and a decrease in HDL cholesterol (which may be an increased coronary artery disease risk). Patients may also be advised to be aware of more aggressive behavior. While laryngeal tissue growth under androgen stimulation may result in the voice deepening that most trans men consider a benefit, the androgen stimulation to those tissues may also increase the risk of sleep apnea.

Osteoporosis is not typically considered a concern for trans men. Similarly, past concern about liver toxicity related to oral androgen products are no longer in use.

Breast cancer has been reported in transgender men who have had chest reconstruction surgery [1]. Therefore, all tissue present must be monitored, including cervical tissue, if present, and breast tissue. After chest reconstruction surgery, screening mammogram will no longer be productive and chest self-exam is most practical. The Endocrine Society currently recommends cancer screening based on the age-appropriate screening guidelines for any existing tissues [3]. However, there is no current evidence to screen at earlier ages in the transgender population.

Surgical Considerations

Most transgender men who seek gender confirmation surgery will be on hormone therapy with testosterone alone. It is the responsibility of the surgeon to obtain letters of referral according to the World Professional Association for Transgender Health (WPATH) guidelines. For breast reconstruction surgery, the current WPATH

Table 8.2 Suggested monitoring for transgender men

1. Clinical assessment and laboratory monitoring every 3 months for the first year then twice yearly
2. Periodic assessment of hematocrit (or hemoglobin) and lipids
3. Measurement of bone mineral density in patients with risk factors for osteoporosis including gonadectomy, personal history of fracture, family history of osteoporosis, low BMI, tobacco or alcohol misuse
4. Screening for cancers in tissue present including cervix and breast should follow recommendations by national societies

Source: Adapted from the Endocrine Society guidelines

guidelines recommend a referral letter without a minimum amount of time on hormone therapy. For gonadectomy surgery (hysterectomy/oophorectomy), the WPATH guidelines recommend 2 referral letters and that the transgender man be on hormones for at least 12 months prior to surgery. Finally, for gender-confirming genital surgery, the WPATH guidelines recommend 2 referral letters, 12 months of continuous hormone therapy, and 12 months living in the desired gender role (Table 8.2).

Like transgender women, the surgeon should review the patient's past medical history and obtain the appropriate consultations for any chronic medical illnesses that may impact the surgery and/or postoperative recovery. Hormone regimens that appear to be supraphysiologic or nonstandard may require a perioperative assessment by an endocrinologist with experience in transgender medicine.

There are no specific testosterone-associated surgical complications known. Therefore, in the author's opinion, there may be no need for trans men to alter their hormone regimens to accommodate surgery. Postoperative hormone regimens are usually unchanged from preoperative regimens except for trans men taking larger testosterone doses than they might have preferred in order to stop menses. In that relatively narrow instance, hysterectomy may facilitate a slight decrease in the testosterone dose.

Conclusions

Most transgender men will take gender-confirming hormone therapy prior to undergoing gender-confirming surgery. The most common routine is exogenous testosterone to achieve typical male testosterone serum levels. The risks of gender-confirming hormone therapy are low, especially when prescribed under medical supervision. Although risks of gender-confirming hormone therapy appear to be low, large prospective cohort studies are needed to measure the long-term risks of therapy [7].

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Photographs

Male Transsexual boy, age 24

Photo a:
A rather effeminate boy, 1963

Photo b:
An inconspicuous girl a few month later (not yet operated).

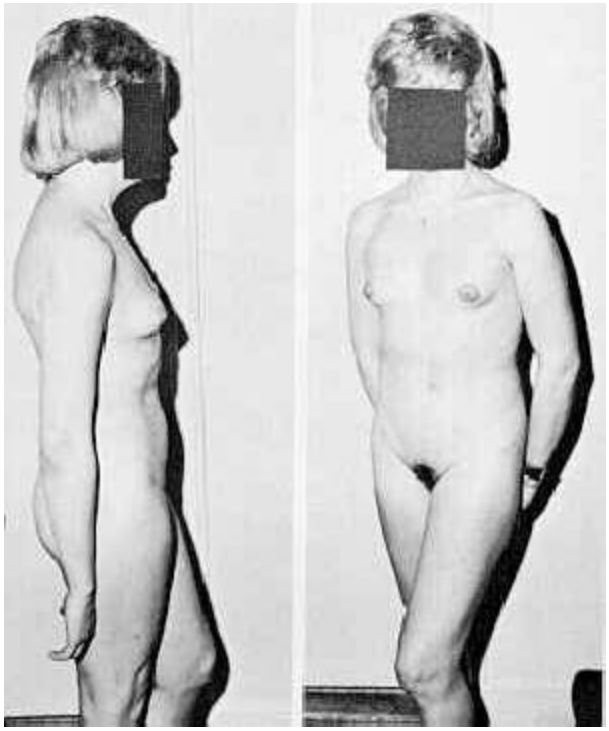
Another patient

Transsexual before any treatment or operation.

Same patient three years previous to treatment in a wish-dreaming mood.

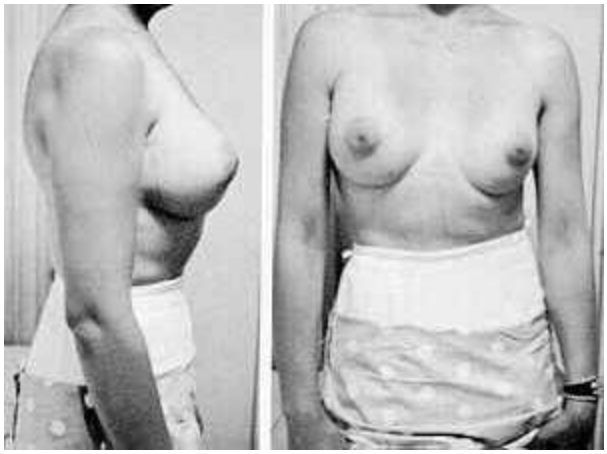
Same patient as a female.

Same patient after breast operation and nearly two years of estrogen therapy (example of exaggerated breast implant).



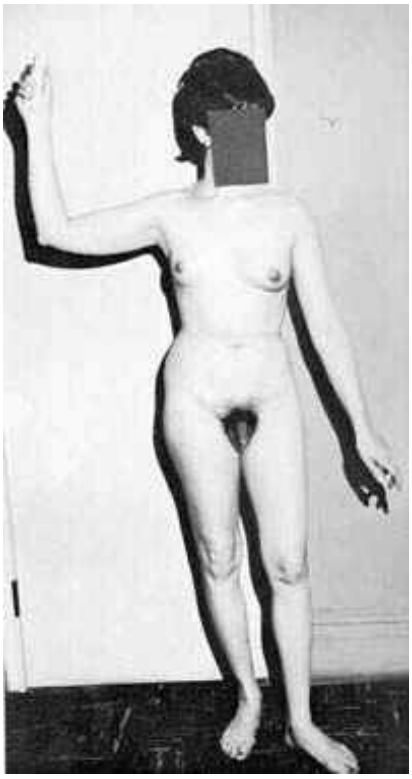
Another patient

Male transsexual after hormone treatment and conversion operation.



After additional plastic breast operation.

Another patient



Statue of an Hermaphrodite

" The astounding monster, born of the lust of a nymph and half-god, shows his ambiguous form amindst the splendor of precious stones." - DÁnnuncio, Lust. *(From H. Lewandowski, Römische Sittengeschichte, Hans E. Günther Verlag, Stuttgart, 1964)*

In photography there are no unexplained shadows.
—August Sander, poster advertising photography exhibition, London Underground, May 1997

epilogue

Transsexuality in Photography—Fielding the Referent

Below the final photograph in Mario Martino's autobiography the caption reads: "Emergence accomplished, at last I'm free to live as I wish and to tell my story." Showing a man with full beard and pipe writing at a desk, the photograph illustrates this "emergence" as man and autobiographer. The pipe and pen serve as evidence for the life as a man and the story, synechdoches for the body and the narrative that substantiate both aspects of Martino's "freedom." Yet the autobiography's preface reveals this freedom is circumscribed. We learn that "Mario Martino" is a pseudonym, the real authorial subject "clinging to a hope of anonymity" behind it because, as he writes, "[t]he merciless shadows of contempt and tragedy still fall on transsexuals."[1] This tension between revelation and concealment, between emerging from the shadow of a hidden gendered self to shelter under the shadow of a disguised written self, is also captured in the photograph. Shot from an awkward angle to the rear of the subject's right shoulder, the portrait masks Martino's identity as it evidences his manhood. In testimony to the truth of the posttransitioned sex

Emergence accomplished, at last I'm free to live as I wish and to tell my story. FROM *EMERGENCE: A TRANSSEXUAL AUTOBIOGRAPHY* BY MARIO MARTINO WITH HARRIET. COPYRIGHT © 1977 BY MARIO MARTINO WITH HARRIET. REPRINTED WITH PERMISSION OF CROWN PUBLISHERS, INC.

of the female-to-male transsexual that yet doesn't reveal its subject, the photograph places most of the face out of the reader's line of vision while positioning beard and pipe prominently within it.

Autobiography and photography, notes Timothy Dow Adams in an issue of *Modern Fiction Studies* devoted to their intersection, are equally haunted by the presence of the referent.[2] Both appear to represent their subject in a strikingly unmediated fashion; both appear to reveal the real. Nevertheless, as forms of representation, both are not the subject itself but its imaging, reproductions of the referent. Occupying similar ground between referentiality and representation, transsexuality might be conceived as a parallel "form." As a transformation of the material body,

transsexuality is inextricably hooked into the register of the real. Yet as this corporeal reconstruction is made possible though narrative and, indeed, as the transsexual self must be represented before it is realized in the flesh, transsexuality is equally bound to representation, dependent on its symbolization to be real. Photographs of transsexuals appearing in transsexual autobiography—an overlaying of three forms of representation that yet cannot do without the referent—triple our sense of the presence of the literal. If the theoretical figuration of transgender has left out the ways in which transgender is literally embodied and lived, photographs of transsexuals in the autobiographies promise, even more than the texts themselves, to recover what has been transubstantiated.

And yet the referentiality of transsexuality proves particularly hard to capture in photography. For if the aim of transsexual reassignment is to erase the visible markers of transsexuality from the body, to erase the trace of the former sex so as to leave the body unremarkably resexed, how can transsexuality as such be represented through the medium of the photograph? Photographs of transsexuals are situated on a tension between revealing and concealing transsexuality. Their primary function is to expose the transsexual body; yet how to achieve this when transsexuality on the body is that which by definition is to be concealed? While the intersection of these forms may provide a veritable pile-up of the referent, catching transsexuality as referent itself requires some fielding.

The effect of photographs in any autobiography, transsexual autobiographies included, is immediately referential. Autobiographical photographs serve to embody the subject of the narrative. This is the real body of the autobiographer, they declare; the text you read refers to this subject you see here. Even in the most willfully anti-representational of autobiographies, *Roland Barthes by Roland Barthes,* the photographs of Barthes appearing in the text work to override Barthes's fragmenting of his self into a medley of writerly codes, underscoring instead the consubstantiality of the subject in the represented body.[3] In spite of the writing's antithetical pull, the photographs establish Barthes as a continuous, unified, and above all real (that is, existing, embodied, and not merely textual) subject.

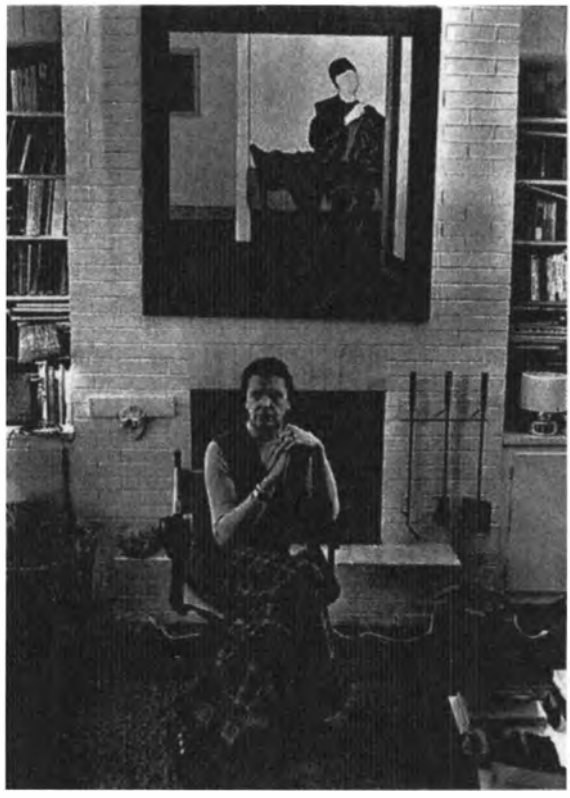
The scene of writing in *Roland Barthes by Roland Barthes* would seem to provide an archetypal poststructuralist description of the subject: that is, not only can writing not simply refer to the subject but subjectivity itself is an effect of signification. This conception of the subject as non-

referential is encapsulated in Barthes's famous question: "Do I not know that, *in the field of the subject, there is no referent?*"[4] This question would render impossible the book's very status as autobiography. For if there is no referent in the field of the subject, then autobiography cannot—as can no form of representation—represent or refer to the self. However, by reading *Roland Barthes by Roland Barthes* alongside Barthes's next and final work, *Camera Lucida*, Paul John Eakin has shown that the last stages of Barthes's thought were very precisely a quest for the referent in the field of the subject.[5] Barthes conducted this quest through photography, begun as we have already noted with the inclusion of photographs in *Roland Barthes by Roland Barthes* and culminating in his "reflections on photography," *Camera Lucida*. Eakin summarizes the substance of *Camera Lucida*—the fact that, as an essay on photography, its subject *is* substance: "In the field of the lens, we might say, there is always a referent, and Barthes beholds in photography the truth that these referents have really existed: 'Every photograph is a certificate of presence.' "[6] Barthes presents photography as a form that overrides the equivocation around the referent in autobiography; the former book's fetishistic question ("Do I not know that," etc.) is recast into an unequivocal assertion about the existence of the referent and the capacity of photography to capture it: "It is reference," he now writes, "which is the founding order of Photography" (*CL* 77). According to *Camera Lucida* the photograph doesn't simply authenticate the referent in the most unmediated fashion; the photograph is in fact "never distinguished from its referent (from what it represents), or at least it is not *immediately or generally* distinguished from its referent" (*CL* 5). The photograph appears as the referent. Thus, Barthes writes, "the Photograph . . . has something tautological about it"; identical to the referent, in representing it, the "sign" appears to disappear (*CL* 5). In photography the medium becomes invisible, and only "the referent adheres" (*CL* 6).

With three exceptions, all of the photographs in *Camera Lucida* take their subject as the human form; they are studies of bodies and faces. And in the writing of this essay Barthes's thought repeatedly follows this same trajectory: from photograph to subject to body. In pursuing the referent Barthes consistently ends up with the body. For instance: "Photography's inimitable feature . . . is that someone has seen the referent (even if it is a matter of objects) in *flesh and blood*, or again, *in person*. Photography, moreover, began historically, as an art of the Person: of identity, of civil status, of what we might call, in all senses of the term, the body's *formal-*

ity" (*CL* 79). In the photographic "field" of the subject, we might say, the referent (what the camera seeks to evidence) is the body. And if Barthes turned to photography for "solace when the austere tenets of poststructuralist theory about the subject came into conflict with the urgent demands of private experience," as Eakin so finely argues,[7] the solace he searches for in a style less and less mediated by theory and more and more immediately personal, is his recently dead mother. Sifting through photographs of her, he looks for her flesh and blood *being*, a way to fill the absence of her body. From structuralism to poststructuralism to this signing off with the referent, the personal, and the search for his mother's presence (mater, matter): is there not something of an allegory in the final trajectory of Barthes's writings, a story for our specific theoretical time?

In the field of the transsexual subject the photograph functions as an incarnation; the photograph appears co-natural with the body, and may even begin as more referential of the self than the body. Inasmuch as the immediate purpose of transsexuality is to make real the subject's true gender on the body, the visual media are highly valued, for they promise (like transition itself) to make visible that which begins as imperceptible—there but underexposed, we might say. With less mediation than writing between signifier and soma, the visual media realize the image of the "true" self that is originally only apparitional. Katherine Cummings recounts how as a teenager beginning to cross-dress, she constructs a self-timing mechanism out of cotton thread and a wind-up key for a cheap Kodak camera, allowing her to take self-portraits. The photographs serve to provide "some concrete evidence of my rare moments of femininity": "Cumbersome and slow but for the first time I could make permanent images of my stolen moments."[8] A painter, Erica Rutherford paints self-portraits based on photographs she first takes of herself dressed as a woman—also concretizations of an imperceptible self. Like Cummings's photographs these portraits begin by envisioning the woman Rutherford wishes to become and are gradually transformed as she transitions into a record of that becoming. In one photograph that appears in her autobiography, a painted self-portrait is situated behind the photographic Rutherford. In the painting the seated figure is feminized through body contour, posture, and clothing, but the face is featureless—a blank space as undetailed by the feminine as the still-masculine face of the photographic Rutherford seated before it. Yet the photographic Rutherford repeats the conven-



FROM ERICA RUTHERFORD, *NINE LIVES: THE AUTOBIOGRAPHY OF ERICA RUTHERFORD* (CHARLOTTETOWN, P.E.I., CANADA: RAGWEED, 1993). REPRINTED WITH PERMISSION OF RAGWEED PRESS

tionally feminine pose of the pictorial Rutherford (knees jammed, legs tightly crossed, hands clasped), so that the painted self-portrait appears as a model for the transsexual body to follow, this self triply textualized—a painting within a photograph within the autobiography—nevertheless reflecting more of the real transsexual self than the subject's visible body. For both Cummings and Rutherford the self-portrait is a blueprint for the transsexual subject in transition: like the photographs in the autobiographies for readers, visual means of making the transsexual's gender real.

The self-portrait (whether written or pictorial) appears to represent the subject in the present moment; this appearance is deceptive, however, for writing and painting can only ever re-present the moment in multi-

ple moments after the fact. Nevertheless, freezing the representation at that instant (or the subsequent split second), photography is the most instantaneous medium. It is this apparent synchronization of image with the object's presence that produces the photograph's referential, tautological texture: the subject was actually there (is still there) in that instant of the photograph. As the original body for the transsexual is that which is to be changed and left behind, however, photographs of transsexuals from the past represent that which is blatantly no longer there: an absented presence. In transsexual autobiographies past photographs are arranged with present ones to form a narrative of the changing body up to the present. The effect is double: as narrative, photographs demand that we concede that transsexuality makes a thorough difference to the body and yet—part of the autobiography—that we discover consistent and continuous identity in that very place of alterity. Four shots appearing on a single page of *Katherine's Diary: The Story of a Transsexual* clearly perform this double function. The photographs convey the empirical differences between male and female personae, John and Katherine: John stalwart and squinting in the sun in crisp white naval uniform; Katherine, wide-eyed, slinky, and seductive in a black dress. And yet, in the way that these differently gendered personae are interspersed on the page (Katherine/John, John/Katherine), the photographs insist on continuity in spite of change. The chronology of dates in the captions asks us to read the photographs across the page into a narrative of transsexual transition and to pay close attention to the differences of their detail: "Katherine at seventeen dressing behind locked doors, 1952"—posing gawkily with rather heavy make-up—graduates to, simply, "Katherine, aged twenty-six, 1961"; the implication of the elision of a descriptive being that she is no longer dressing as Katherine but simply *being* her. Indeed, the low-cut top in the final photograph draws the eye to the beginnings of a breast cleavage, and later shots in *Katherine's Diary* reveal a progressively feminizing body by progressively revealing more of this body (via the backless dress to the bikini). Voluptuous in her bikini, Katherine is so "there" in a later photograph, "In the raging surf, Christchurch, New Zealand," so evident in her reassigned sex, that she no longer even requires naming.

Why *these* images? What of the self does the transsexual autobiographer consider representable? The question is especially poignant for the transsexual when s/he no longer *is* that self, when presenting the photo-

(1) Katherine at seventeen, dressing behind locked doors, 1952; (2) John aged eighteen, defending the nation, 1954; (3) Sub-Lieutenant Cummings, RANR, 1960; (4) Katherine aged twenty-six, 1961. FROM KATHERINE CUMMINGS, *KATHERINE'S DIARY: THE STORY OF A TRANSSEXUAL* (PORT MELBOURNE, VICTORIA: HEINEMANN, 1992). REPRINTED WITH PERMISSION OF KATHERINE CUMMINGS

In the raging surf, Christchurch, New Zealand, 1975. FROM KATHERINE CUMMINGS, *KATHERINE'S DIARY: THE STORY OF A TRANSSEXUAL* (PORT MELBOURNE, VICTORIA: HEINEMANN, 1992). REPRINTED WITH PERMISSION OF KATHERINE CUMMINGS

graph within the autobiography is (more than the autobiography even) an act of incarnating what one is not. How to represent in the visual the body to which one's self no longer (indeed never) refers? Captions clue us in to reasons for the choice of photographs. They reveal the trace of the subject's re-vision, what s/he sees in looking back at him- or herself. In Paul Hewitt's *A Self-Made Man: The Diary of a Man Born in a Woman's Body*, the author's caption, "I was already acting the role of the protective brother," brings out as masculine the bodily posture of the ambiguous child sitting on a tree stump—one arm around twin sister, the other propped on a firmly parted knee. Martino's "My ambiguity was evident at an early age" has the same effect: again, as in the narrative but more so because photography is so evidentiary, "I was (already) there!" Challenging the evidence of the transsexual photograph (in effect: "no *he* was not!"), Bernice L. Hausman finds the caption unsubstantiated by the

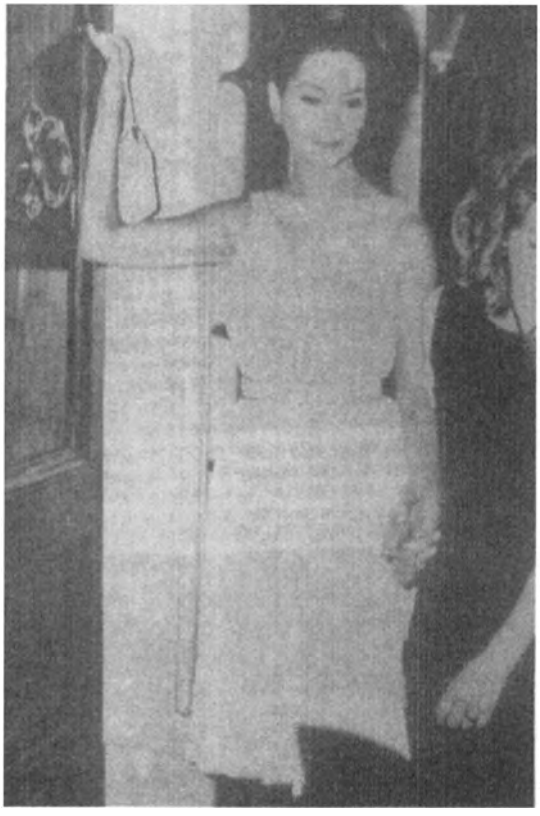
I was already acting the role of the protective brother. PAUL HEWITT WITH JANE WARREN, *A SELF-MADE MAN: THE DIARY OF A MAN BORN IN A WOMAN'S BODY* (LONDON: HEADLINE, 1995). REPRINTED WITH PERMISSION OF PAUL HEWITT

image; she writes of this and another of Martino's photographs ("Boy's Face in Banana Curls"), "For [Martino], these pictures undeniably document her childhood masculinity (as the captions confirm), yet both merely offer the reader images of a child whose sex is largely indicated by clothing. A three-year old child with short hair is generally somewhat asexual; that is why children's, even infants', clothes are so conspicuously sex-coded. Some children maintain this sexlessness until puberty."[9] Through the minimizing force of that "merely" and the universalizing impact of that "generally" (still putting the transsexual in the dock), Hausman abrogates not only the specific evidence of the photograph for Martino but the knot of pain and contradiction entailed in representing one's transsexual past in this most unmediated of forms. If Martino's captions cope with the pain of return to the pretransition body by incorporating the photograph and smoothing over the difference, April Ashley's, for instance, perform its severing, a detachment of the unwanted past that leaves the difference starkly remarkable. Representing herself as a woman, April, Ashley's captions summarize the photographic event: "The blind leading the blind: in Rome with Sarah Churchill, 1964." But

My ambiguity was evident at an early age. FROM *EMERGENCE: A TRANSSEXUAL AUTOBIOGRAPHY BY* MARIO MARTINO WITH HARRIET. COPYRIGHT © 1977 BY MARIO MARTINO WITH HARRIET. REPRINTED WITH PERMISSION OF CROWN PUBLISHERS, INC.

when the boyhood self is pictured, invariably, he is formally and doggedly named, disowned by Ashley the autobiographer, as though his body were really another's, as though this representation were too not-me to be owned: "V.E. Day, May 1945, George Jamieson at St. Theresa's Primary School, Liverpool"; "George Jamieson, aged thirteen, with brother Ivor (nine) and sister Marjorie (seven) at home, Norris Green."

And indeed, when we turn from April to this boy, is George Jamieson not an other? For when the photograph is not a likeness, when it no longer represents the self, surely it ought to be said that then it is not a portrait. In every photograph, writes Barthes, because of the apparent presence of the referent, there is "that rather terrible thing . . . the return of the dead" (*CL* 9). Photographs of a pretransition self threaten to incarnate a "dead" self that one is not. In the case of Leslie Feinberg, as a subject whose transition doubles back, this reincarnation is twice over for hir parents:



The blind leading the blind: in Rome with Sarah Churchill, 1964. FROM DUNCAN FALLOWELL AND APRIL ASHLEY, *APRIL ASHLEY'S ODYSSEY* (LONDON: CAPE, 1982). REPRINTED WITH PERMISSION OF ERIC GLOSS LTD.

> When I first entered a sex change program a decade ago, in order to avoid embarrassment my parents disposed of all pictures of me, a little girl or young woman growing up with the tenseness of puberty etched on my face. When I later took back control of my body after four years of being on the program, my parents discarded all the pictures of me living as a man.[10]

Most representational of forms, talisman of the subject, the photograph *must* be seen to represent the subject. Its spectral power is huge. The haunting feeling of at once self-recognition and self-alienation we all experience when we see ourselves in the photograph (both "So that is me!" and at the same time "That cannot be me!") is redoubled for the transsexual looking at the pretransition portrait—that doppelgänger of

(1) V. E. Day, May 1945, George Jamieson at St. Theresa's Primary School, Liverpool; (2) George Jamieson, aged thirteen, with brother Ivor (nine) and sister Marjorie (seven) at home, Norris Green. FROM DUNCAN FALLOWELL AND APRIL ASHLEY, *APRIL ASHLEY'S ODYSSEY* (LONDON: CAPE, 1982). REPRINTED WITH PERMISSION OF ERIC GLASS LTD.

the subject that is yet not a double. In the "return of the dead," surely, the particular fear at work is that the image is more real than the subject; that the photograph *is* the referent. Is there not an unconscious fear that (like a legendary encounter with a self-portrait in the attic) an encounter with the image one is not might change the body back to what "nature" decrees it should have been? In the case of the theatrical Coccinelle, most famous of Paris's *travestis*, the way to avoid such an exchange is to "kill" the image—a killing that is not of just an image but of that "dead" self itself:

> When I got up, I had only one thought—to destroy Jacques Dufresnoy, who had stolen my real "ego," to get rid of this interloper who had made me assume a false outer covering. On the chest of drawers I saw a photograph of myself—myself as a boy. How revolting! I snatched up the frame, threw it down and trampled on it. Pieces of glass were scattered all over the floor. I picked up the photograph and tore it up. . . . Then I opened a drawer and took out a whole pile of photographs and negatives dealing with my childhood, my family and my life as an effeminate boy. Oh how I hated him, that creature of a sex that was not really mine! . . . I set to and destroyed them all. . . . In the end there wasn't a single photograph of me left in the house. I had burned them all.[11]

In fact, one photograph of this "false outer covering" boy remains. Interloping his way appropriately as an inset onto the cover of Coccinelle's "interview" with Mario Costa, "Jacques" appears as a melancholic pierrot-type figure, as *himself* barely substantial. Within the text, by contrast, there is a mass of photographs of the very substantial Coccinelle next to him—the true self within. This thick wad of mostly nude pictures of the Bardot-look-alike Coccinelle—Coccinelle in the bath, Coccinelle in the shower, Coccinelle stepping out of a mink at her bar ("Strictly Adult Sale": to be read only at the front desk of the British Library under the librarian's scrutinizing eye)—is in fact the text's raison d'être. The function of the photographs is to reveal all; the camera, they suggest, cannot lie: "An impromptu strip-tease, beautiful, slender, and completely feminine, Coccinelle proves in this delightful sequence . . . that she can face the camera from any angle. Proof beyond doubt of this living miracle of Man Made Woman."[12] Is this not realness? the photographs demand. And is not realness a turn-on: what everyone *desires*?

If the photograph insists on itself as documentary evidence, who is to decide if the referent is "there" or not? Hausman's reading of Martino

COVER, MARIO COSTA, *"COCCINELLE": REVERSE SEX*, TRANS. JULES J. BLOCK (LONDON, CHALLENGE, N. D.)

FROM MARIO COSTA, *"COCCINELLE": REVERSE SEX*, TRANS. JULES J. BLOCK (LONDON, CHALLENGE, N. D.)

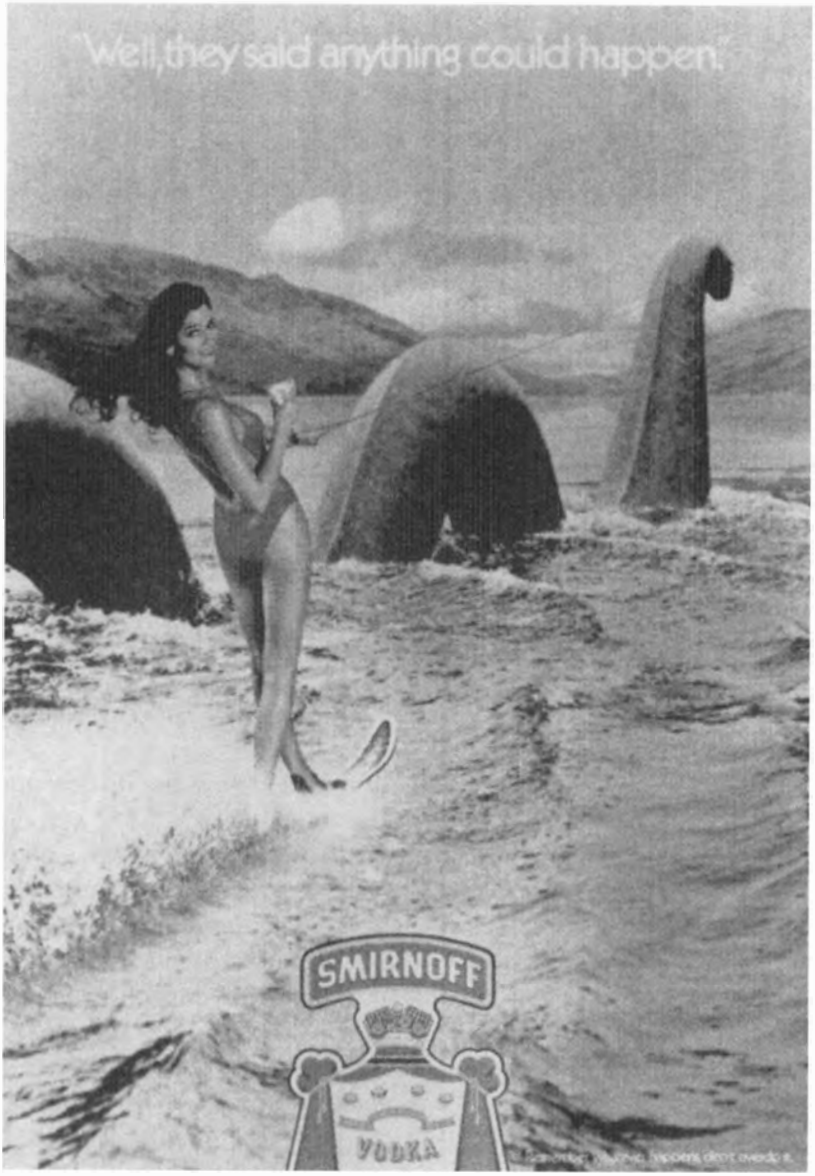
brings into focus (it's a self-focusing we might say, the critic's lens turning on itself) the problematics of *reading* the transsexual in the photograph. Barthes suggests that "because of its evidential power" (*CL* 106) the photograph in fact cannot be read: "It is precisely in this *arrest* of interpretation that the Photograph's certainty resides" (*CL* 107). The more evidentiary the photograph, the less of a reading it requires—or allows: "it is in proportion to its certainty that I can say nothing about [the] photograph" (*CL* 107). Some photographs of transsexuals blatantly refuse a reading. Of two pretransition shots of Caroline Cossey as Barry, first as a child and then at sixteen (next to a posttransition shot of Cossey as "Tula" as her model self was better known, shown in the Smirnoff campaign whose slogan—once Cossey was outed as transsexual—itself was fabulously literalized); of images of Raymond Thompson, first tracing his childhood, then three years into hormone treatment at nineteen; because of the certainty in my eyes of what they evidence (the certainty that Barry is already really Caroline—the combinative effect of those eyes, those lips, and that nose; the conviction that Ray has never

As a young boy with a horrendous short-back-and-sides that did me no favours. FROM CAROLINE COSSEY, *MY STORY* (WINCHESTER, MASS.: FABER, 1992). REPRINTED WITH PERMISSION OF CAROLINE COSSEY

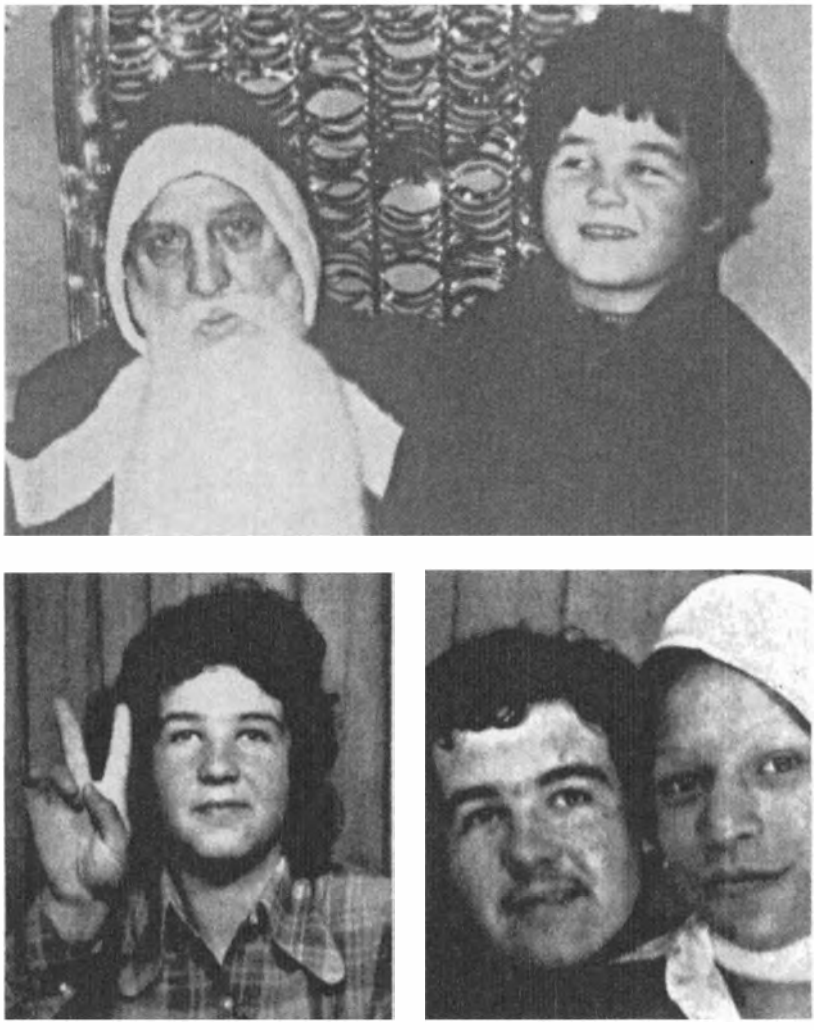
In London at sixteen. FROM CAROLINE COSSEY, *MY STORY* (WINCHESTER, MASS.: FABER, 1992). REPRINTED WITH PERMISSION OF CAROLINE COSSEY

been anyone else), I find I have literally nothing to say. For do they not speak the transsexual's true gender for themselves?

More than the written text of transsexual autobiographies, the photographs bring into relief the reader's gaze. Asking us to consider what nuances of gender we see in these images in looking at the transsexual, they also ask: how do *we* look?—where "look," as Teresa de Lauretis has suggested in the context of lesbian and gay film theory, should be heard as both transitive and intransitive verb.[13] That is, how do we look at the other and what look do our own bodies cast to the world? How is our reading of the transsexual invested in and produced by own gendered and sexual subject positioning, our own identifications and desires? Photographs of the transsexual, particularly of the transsexual in transition, push *us* up against the limits of gendered representation: the limits of what about gender we can consign to representation, of what we can process as identity in the visual. A series of photographs from *Second Serve* charting Dick Raskind's transformation into Renée Richards captures the subject's body in the most transitional moments of

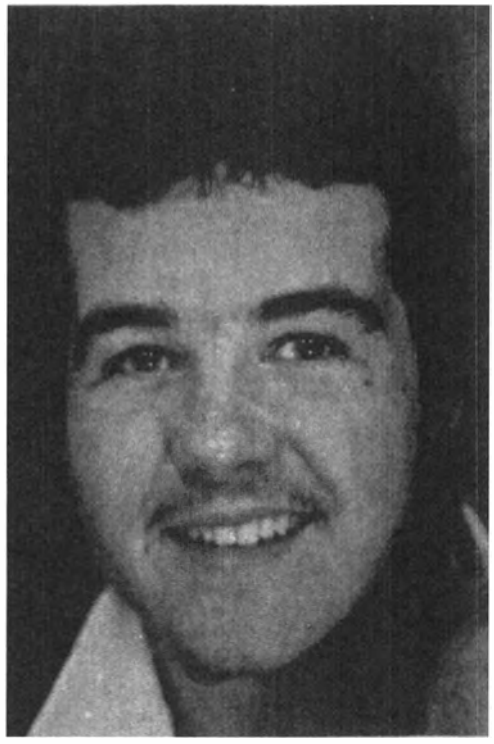


The famous Smirnoff shot. REPRINTED WITH PERMISSION OF INTERNATIONAL DISTILLERS & VINTNERS LTD.



(1) Still pinning hopes on Father Christmas, aged 7; (2) Rebel with a cause, aged 13; (3) At 16, a precious picture of early days with Loretta (aged 21). FROM RAYMOND THOMPSON WITH KITTY SEWELL, *WHAT TOOK YOU SO LONG? A GIRL'S JOURNEY TO MANHOOD* (LONDON: PENGUIN, 1995). REPRINTED WITH PERMISSION OF RAYMOND THOMPSON

her transition, during which the subject's gender is quite indeterminate, when Richards appears, as she writes in her autobiography, as a "man-woman," "a hermaphroditic spirit."[14] There's a precarious androgyny to her body and face in these central images that makes it difficult to read her as either a man or a woman, that makes it difficult to read her alto-



Ray, aged 19. FROM RAYMOND THOMPSON WITH KITTY SEWELL, *WHAT TOOK YOU SO LONG? A GIRL'S JOURNEY TO MANHOOD* (LONDON: PENGUIN, 1995). REPRINTED WITH PERMISSION OF RAYMOND THOMPSON

gether. If the photographs before this series evidence Richards as a man and those after as a woman, do these intermediate photographs represent her at her most transsexual? What does transsexuality in fact look like? Photographs that establish gendered realness do not *reveal* transsexuality, for in them the subject passes as nontranssexual. The problem of reading the transsexual in the photograph heightens the tension around reading and passing that inhabits all transsexual representation.

Bettina Rheims's photographs of French male-to-female transsexual Kim Harlow engage exactly this problematic.[15] Rheims's photographs, together with Harlow's own autobiographical fragments, make up the brief text, *Kim*, but although Harlow is listed as the text's first author, Rheims is *Kim*'s real author. Her photographs are stylized and finished while Harlow's writings have an abbreviated quality (indeed, the note opening the text states that Harlow "was unable to finish her story" as

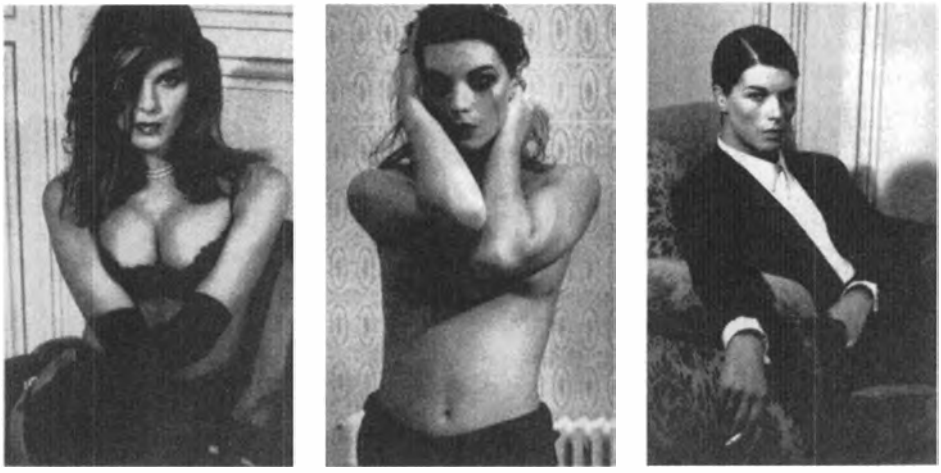
(1) Featured on the cover of a Long Island newspaper supplement, September 1973; (2, *inset*) With Andy in 1973. FROM RENÉE RICHARDS WITH JOHN AMES, *SECOND SERVE: THE RENÉE RICHARDS STORY* (NEW YORK: STEIN, 1983)

AIDS "cut short this work, her work" [5]). And of Kim the photographic subject, Rheims is sole author, her images producing the transsexual as model-perfect, killer-sexy. Kim is presented wearing little, but just enough: plunging-front sequined and cutaway fishnet bodysuits, lace bra, panties, stockings, and suspenders; these clothes serve to reveal perfect breasts and, in one photograph, the top of a perfect crotch.

Yet herein lies the problem for Rheims. Kim is so real, so passing, how to represent her as a transsexual? She won't reveal herself as a boy. That is, not only does her "boyness" not show on her transsexual body, Rheims notes that Kim "had always refused to show me photos taken of herself when she was still Alexandre" (24). Rheims attempts to make legible Kim's transsexuality, therefore, by restaging her transsexual history; except that, starting out with Kim's gendered realness as her representa-

tional material, Rheims can only create her as transsexual by moving back from female to male. In Harlow's description, "Bettina does tell my story but backwards. First you see me looking really feminine and sensual, going out, walking around in a big hotel, then in my room in a négligée, in my lingerie, then naked, then bit by bit you see me gradually lose my composure and cry. You see me taking off my make-up and at the end I'm dressed as a boy" (16–19). From woman to "boy"—notably, not "man": the transsexual narrative proves irreversible; in spite of the implication of the photographic sequence, it cannot "go either way." Indeed, do not the last shots of Kim cross-dressed as "male" show a still-beautiful, sexy (now boyish) *woman*?

Even so, there is something in this reversal of the narrative that sublimates transsexuality even as its purpose is to capture it. Alexandre has *passed*; he is not *there* in the photographs. As Harlow notes: "The pictures are very beautiful—they're not autobiographical, but they all have something in them that I've lived through. When I saw them I said to myself that they were a kind of sublimation of everything I'd experienced, it was really . . . I can really see myself in them. A wonderful gift from Bettina" (8; ellipses in original). Given Harlow's realness as a woman and her refusal to show past photographs of Alexandre, Rheims must resort to *her* imaginary in order to represent Kim as a transsexual, as Alexandre. Reversing the narrative and representing the somatic transitions of transsexuality as a quick change of clothes—from difficult body narrative to palatable gender performative—Rheims's imaginary sublimates the real



FROM KIM HARLOW/BETTINA RHEIMS, *KIM*, TRANS. PAUL GOULD (MUNICH: KEHAYOFF VERLAG, 1994)

experience of transsexuality: the referent of transsexuality is elided (hence, surely, Kim's ellipses) in Rheims's recreation. Even in her fictionalization of Kim as Alexandre, Rheims fails to create a passing woman—a woman who passes successfully as a man.

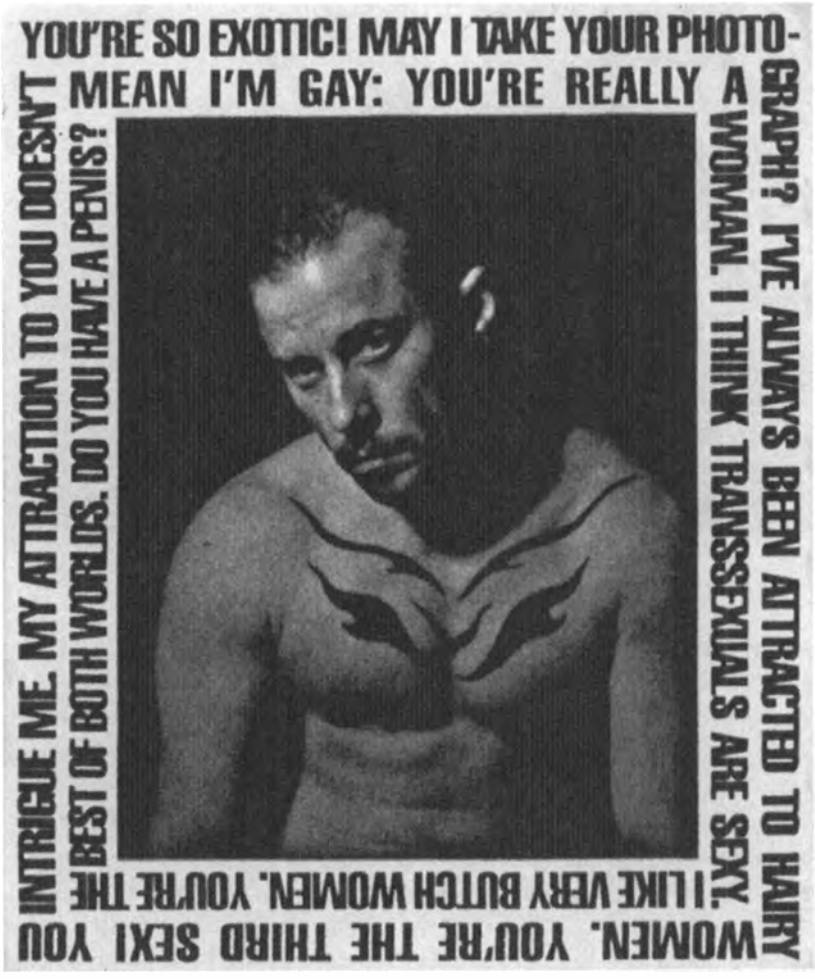
The middle shots in the series are particularly disturbing. They represent Kim in the stages of reverse "transition." She faces the hotel bathroom mirror, her top now off and jewelry gone, her eye make-up streaking her face; remember, she notes crying during this scene. In some images, as she scoops her hair back, she tries to conceal her breasts. These gestures look as awkward as they sound: Kim appears uncomfortable, almost gawky. These central shots represent Kim at her least posed, most naked—her most "real." Yet as the camera would appear to capture the transsexual real, the mirror serves to displace it. Only in one photograph can we see its frame; but all seven "transition" pieces are shot of the reflection in the mirror, the specular image, and not of Kim, the referential subject. There are two clues: the radiator, which remains in the bottom right corner of every shot, including the one that reveals the mirror's frame (if Rheims had shot Kim directly in any of the others, the radiator would have appeared on the bottom left); and the fact that, in two of the shots, Rheims catches the subject's nonspecular arm within the photographic frame, a blur partially concealing the reflection. Rheims must have shot all these photographs from some point to the right of (the referential) Kim, focusing on the reflected image. As well as reversing the narrative, therefore, when this body is at its least posed and most expressive—at its most "real"—the mirror serves to refract our gaze and to displace the real transsexual. While Kim's beautiful transsexual body is the object of the camera's gaze throughout the book, the double in the mirror holds at bay the real subject without blocking our view, framing the transsexual in a doubled specularity that prevents her from returning the camera/viewer's look. Like Medusa's head in Perseus's shield, this sequence before the mirror suggests, in Rheims's photographs, the "real" transsexual can only be looked at and "captured" in her reflection, in the imaginary. The specular creates Kim as the object of our look (the mirror doesn't prevent our looking via the specular image), yet it dislocates and confuses its site of production, discouraging that all-important question: how do I look?

What does it mean to consign transsexuality to the imaginary, to sublimate its narrative to reversible performance and let slip its referent in this most referential of forms? Doubtless the strength of my response to these images of Kim has everything to do with how *I* look. My "fierce

protectiveness" over Kim's body, as one colleague termed it after I gave a talk on the photographs, is admittedly a product of my identification with Kim: against the odds of my narrative, my identification with the "all-woman" Kim, and my corresponding anguish over that figure of the pretransition boy.[16] As transgender studies makes its entry into the academy, however, the two questions Rheims's photographs raise—how to represent transsexuality and who is representing transsexuality—are of massive general significance. The importance of sustaining the experience of transsexuality in the midst of theory's sublimation of what's real about this experience—and the concomitant question of whether transsexuality itself can reveal the strings behind the disappearance of the referent in theory—strike me as paramount.

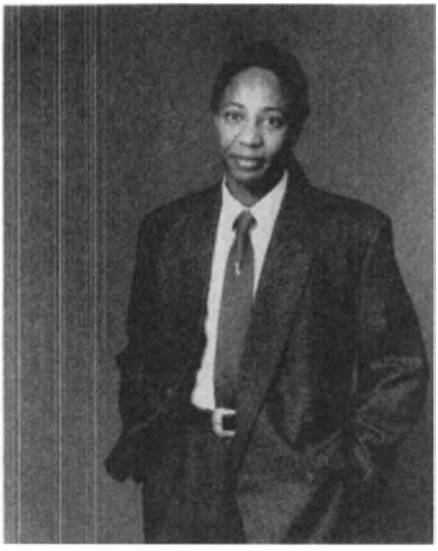
Photographers Loren Cameron's and Del LaGrace's recent work intersect the autobiographical, the photographic, and transsexual representation in ways that contribute important responses to these questions. Cameron's *Body Alchemy: Transsexual Portraits*, as he writes, is "the first photodocumentation of transsexual men from within our community," and as such, a work documenting female-to-males by a female-to-male, his project is groundbreaking.[17] Presenting his subjects as looking "just like men" against the backdrop of their real-life situations ("Fellas"), Cameron sustains the value of gender realness. At the same time in his "Our Bodies" series, in the close-ups of surgical reconstruction, he conveys the material differences of the female-to-male body. But while Cameron lets us look at this referential difference, he also captures how we look. In his self-portraits in the "Distortion" series near the beginning of the book, Cameron's inscriptions of address to the viewer ("You're so exotic! May I take your photograph .... Do you have a penis?") literally frame the viewer's gaze, reflecting back, here, that look of fascination, objectification and desire s/he may cast. We can only look at the transsexual, then, if we look at how we look.

Del LaGrace's photographic work-in-progress of female-to-male Zachary Nataf similarly allows an encounter with the referentiality of transsexual experience while foregrounding point of view.[18] Like Kim this is a work designed to capture the transsexual in transition; but LaGrace's set-up with Nataf couldn't be more different from Rheims's with Harlow. As Nataf initiated the project, the transsexual's representation is self-authored: as LaGrace so nicely puts it, the work is Nataf's "visual transsexual autobiography." Seen together the photographs do indeed have the quality of a document or a record. Meeting every few


YOU'RE SO EXOTIC! MAY I TAKE YOUR PHOTO-
MEAN I'M GAY: YOU'RE REALLY A
GRAPH? I'VE ALWAYS BEEN ATTRACTED TO HAIRY
WOMAN. I THINK TRANSSEXUALS ARE SEXY.
WOMEN. YOU'RE THE THIRD SEXI YOU
I LIKE VERY BUTCH WOMEN. YOU'RE THE
INTRIGUE ME. MY ATTRACTION TO YOU DOESN'T
BEST OF BOTH WORLDS. DO YOU HAVE A PENIS?

FROM *BODY ALCHEMY: TRANSSEXUAL PORTRAITS* (SAN FRANCISCO, CLEIS, 1996). PHOTOGRAPH © LOREN CAMERON. REPRINTED WITH PERMISSION OF CLEIS PRESS, SAN FRANCISCO

months to capture the body in the process of its changing, photographer and subject preserve the narrative structure of Nataf's transsexuality. The photographs convey with scientific precision the actual somatic progressions entailed in Nataf's becoming a man: the changes in body contours, tissue structure, skin texture; and most recently his chest's recovery from surgery. Moreover, the photographer's investment in and identification with his transsexual subject is indicated in how much we get to see of Nataf's transitioning body. Nataf appears naked in many



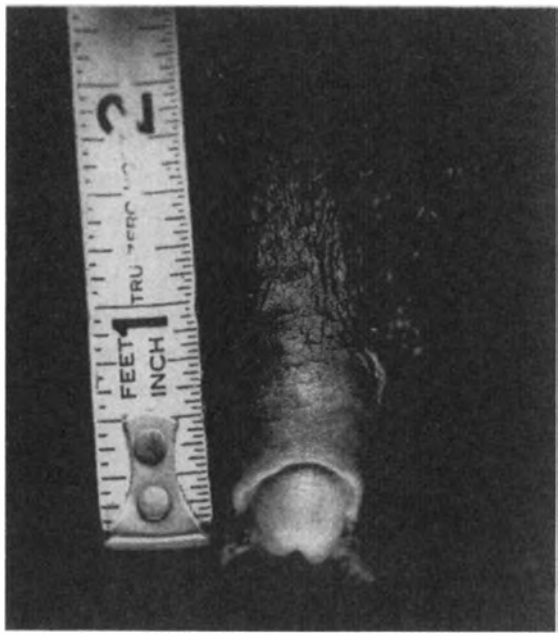
PHOTOGRAPHS BY DEL LAGRACE

images and is happy to let LaGrace in as close as he can get: a marker of the subject's absolute trust that LaGrace's regard, both as a transgendered subject himself and someone whose work over the past fifteen years has broadcast his desire for transgendered subjects, will carry how he—LaGrace—looks. (When LaGrace began taking the images, ***she*** was a "hermaphrodyke," now ***he*** identifies as an intersexual female-to-male; his analysis of the complex role played in his transition by this looking cogently suggests the essential role played in ***all*** transitions by representation.) Criss-crossed with his identification and desire, representing Nataf so intimately in every sense, LaGrace's photographs pass this trust on to their viewers; in their very revelation they demand that we continue its exchange.

What stands out in the series so far are the close-ups of Nataf's genitals. Nataf describes this focus as deliberately ethnographic, anthropometrical, its purpose to reveal graphically the difference of the transsexual body. And indeed, the primary effect of the startling detail of these images is to demand that the viewer take the full measure of the transsexual body—in this shot quite literally. In this regard for size, the photographs make knowing reference to a cultural tradition of phallicizing black male bodies, turning that history of racial fetishization in on itself (since Nataf's male body is evidently different, this representation inter-

rupts that history) to challenge the fetishization of transsexual bodies. For while by no means identical or historically proportionate to the fetishization of black bodies, the fact that *trans* is simultaneously everywhere—subject of contemporary cultural projections—and nowhere—in reality absent, missing in the flesh—is the result of a similar fetishistic splitting between the subject and object of the look, a comparable dearth of self-representations in an abundance of representations of this body as other.[19] LaGrace and Nataf's project directly intervenes into that fetishization of trans by redistributing the look. The fact that Nataf's bodily revelations are his deliberate self-authoring and LaGrace's observation is participant blurs the difference between looking subject and seen object, and as a result the distinctness of the transsexual body emerges clearly into view without disavowal.

What remains of fetishism within the image—and the absolute focus on the genitals does constitute a deliberate attention to these parts apart from the rest of the body—remains in provocative affirmation of the transsexual's bodily difference. Paradoxical as this may seem, the close-up of the transsexual body works to close up the difference between

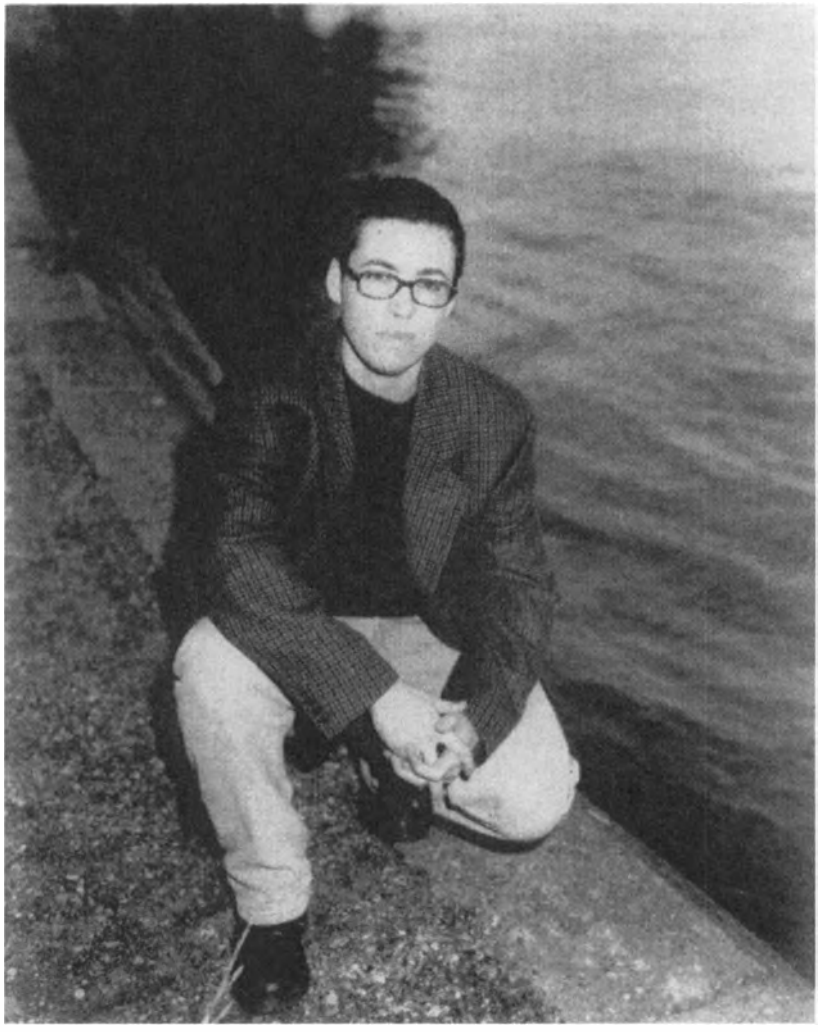


PHOTOGRAPH BY DEL LAGRACE

viewer and transsexual subject—not simply between LaGrace and Nataf but between Nataf and the viewer of the photograph. This dynamic of intimate looking is immediate and unmediated (LaGrace describes it as "physical"), almost—though not quite—beyond narrative: looking so closely at the photograph of this bodily difference, you cannot help but wonder first, surely, *what* you are looking at. You're looking at a body part, that much is clear. Yet what body part? Failing to recognize it, you must search for a reference point in the flesh you know best (your own), quickly envisioning how you look: how you look next to Nataf's body, alongside his body, even as his body. In this way, in its very representation of the adamantine difference of this flesh, the photograph draws you inexorably into its picture. Arresting your look—that is, not only holding your look but rooting it (locating it), it demands from *your* body a narrative: How do *you* look? What do you see here? And what does what you see here reveal about you?

For those unfamiliar with transsexual bodies, these shots of Nataf's clitoris-turning-penis certainly require a double-take. When I first showed these images, some in the audience not surprisingly at first thought Nataf already had a penis. And this, I think, is the ultimate achievement of these photographs: to hold these moments of its turning, to capture without sublimation and objectification the details of the transsexual's transition. Nataf's genitals reveal him as no longer female (there is no reading) but neither as a genetic male (there is no passing); rather they represent him as a transsexual man in the process of becoming. Capturing this flesh as the referent of his narrative, LaGrace's photographic field overturns the transubstantiation and, indeed, the very otherness of the transsexual body.

What needs to be sustained as we write transsexuality into theory is precisely the embodied specificity of the point of regard. Translating Adrienne Rich's politics of location into her poetics of location, Nancy K. Miller suggests that the autobiographical act, "one's own body"—what I understand as some kind of positioning of one's own body in the regarded picture—"can constitute an internal limit on discursive irresponsibility."[20] Taking her literally here, I blow my cover, and embody my narrative with this photograph.



PHOTOGRAPH BY DEL LAGRACE